

# PATENT ABSTRACTS OF JAPAN

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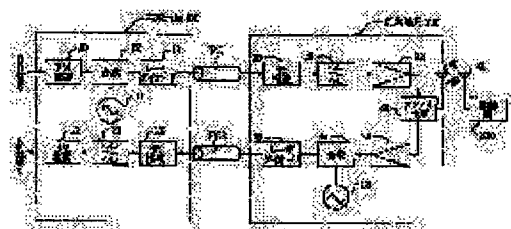
## (54) LIGHT TRANSMISSION SYSTEM FOR RADIO LINK

### (57)Abstract:

**PURPOSE:** To provide a light transmission system for radio link which has the simple constitution compared with the conventional example, connects a master base station and a slave base station without using the radio line and can transmit a signal for radio link.

**CONSTITUTION:** At a master base station 100, a carrier signal is modulated by an information signal, the modulated signal is outputted, and on the other hand, a local oscillating signal is generated. Next, by using non-linear electric and light converting characteristics, the modulated signal and the local oscillating signal are mixed, and so as to generate the signal of at least one mixing frequency component between these respective signals, the electric and light conversion is performed, and a light signal including the signal of the mixing frequency component is outputted to a light transmission line FC1. On the other hand, at a slave base station 200, the light signal transmitted through the light transmission line FC1 is light and electric

converted, an electric signal including the mixing frequency component is outputted, the signal of the mixing frequency component decided beforehand out of the outputted electric signals is band-filtered, and the filtered signal of the mixing frequency component is radio-transmitted.



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CLAIMS

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[Claim(s)]

[Claim 1]A lightwave transmission system for radio links provided with an optical transmission line which connects a main base station and \*\*\*\*\* in which only a predetermined distance separated and was provided from the above-mentioned main base station characterized by comprising the following, and the above-mentioned main base station and the above-mentioned \*\*\*\*\*.

A modulation means which modulates the above-mentioned main base station with an information signal into which a carrier signal which has predetermined frequency is inputted, and outputs a modulating signal.

A signal generation means which generates a local oscillation signal which has predetermined frequency.

A modulating signal which has nonlinear electrical and electric equipment and light transfer characteristics, and is outputted from the above-mentioned modulation means, and a local oscillation signal generated by the above-mentioned signal generation means, So that the above-mentioned modulating signal and the above-mentioned local oscillation signal may be mixed using electrical and electric equipment and the light transfer characteristics of the above-mentioned non-linearity and a signal of at least one mixed frequency ingredient between the above-mentioned modulating signal and the above-mentioned local oscillation signal may arise. Have an electric light converting means which outputs electrical and electric equipment and a lightwave signal which carries out light conversion and includes a signal of the above-mentioned mixed frequency ingredient to the above-mentioned optical transmission line, and the above-mentioned \*\*\*\*\*.

Light and an electrical transducing means which outputs light and an electrical signal which carries out electrical conversion and includes a signal of the above-mentioned mixed frequency ingredient for a lightwave signal transmitted via the above-mentioned optical transmission line from the above-mentioned electric light converting means

an account of the upper by which wave filtration was carried out by wave filtration means which carries out zone wave filtration of the signal of a mixed frequency ingredient beforehand decided among electrical signals outputted from the above-mentioned light and electrical transducing means, and the above-mentioned wave filtration means — a transmitting means which carries out wireless transmission of the signal of a mixed frequency ingredient decided beforehand.

[Claim 2]A lightwave transmission system for radio links provided with an optical transmission line which connects a main base station and \*\*\*\*\* in which only a predetermined distance separated and was provided from the above-mentioned main base station characterized by comprising the following, and the above-mentioned main base station and the above-mentioned \*\*\*\*\*.

A reception means which the above-mentioned \*\*\*\*\* carries out radio receiving of the sending signal which has the predetermined radio frequency by which wireless transmission was modulated and carried out with an information signal in a distant office, and outputs an input signal.

A signal generation means which generates a local oscillation signal which has predetermined

frequency.

An input signal which has nonlinear electrical and electric equipment and light transfer characteristics, and is outputted from the above-mentioned reception means, and a local oscillation signal generated by the above-mentioned signal generation means, So that the above-mentioned input signal and the above-mentioned local oscillation signal may be mixed using electrical and electric equipment and the light transfer characteristics of the above-mentioned non-linearity and a signal of at least one mixed frequency ingredient between the above-mentioned input signal and the above-mentioned local oscillation signal may arise. Have an electric light converting means which outputs electrical and electric equipment and a lightwave signal which carries out light conversion and includes a signal of the above-mentioned mixed frequency ingredient to the above-mentioned optical transmission line, and the above-mentioned main base station, Light and an electrical transducing means which outputs light and an electrical signal which carries out electrical conversion and includes a signal of the above-mentioned mixed frequency ingredient for a lightwave signal transmitted via the above-mentioned optical transmission line from the above-mentioned electric light converting means

A wave filtration means which carries out zone wave filtration of the signal of a mixed frequency ingredient beforehand decided among electrical signals outputted from the above-mentioned light and electrical transducing means, and a demodulation means which restores to a signal of the above-mentioned mixed frequency ingredient by which wave filtration was carried out, and outputs the above-mentioned information signal by the above-mentioned wave filtration means.

[Claim 3]A main base station.

The 1st which connects \*\*\*\*\* in which only a predetermined distance separated and was provided from the above-mentioned main base station, and the above-mentioned main base station and the above-mentioned \*\*\*\*\* , and the 2nd optical transmission line.

Are the above the lightwave transmission system for radio links which it had, and the above-mentioned main base station, A modulation means which modulates a carrier signal which has predetermined frequency with the 1st information signal into which it is inputted, and outputs a modulating signal, The 1st signal generation means that generates the 1st local oscillation signal that has predetermined frequency, A modulating signal which has nonlinear electrical and electric equipment and light transfer characteristics, and is outputted from the above-mentioned modulation means, and the 1st local oscillation signal generated by the 1st signal generation means of the above, So that the above-mentioned modulating signal and the 1st local oscillation signal of the above may be mixed using electrical and electric equipment and the light transfer characteristics of the above-mentioned non-linearity and a signal of at least one mixed frequency ingredient between the above-mentioned modulating signal and the 1st local oscillation signal of the above may arise. Have the 1st electric light converting means that outputs electrical and electric equipment and the 1st lightwave signal that carries out light conversion and includes a signal of the above-mentioned mixed frequency ingredient to the 1st optical transmission line of the above, and the above-mentioned \*\*\*\*\* , The 1st light and electrical transducing means that outputs light and an electrical signal which carries out electrical conversion and includes a signal of the above-mentioned mixed frequency ingredient for the 1st lightwave signal transmitted via the 1st optical transmission line of the above from the 1st electric light converting means of the above, The 1st wave filtration means that carries out zone wave filtration of the signal of the 1st mixed frequency ingredient beforehand decided among electrical signals outputted from light and an electrical transducing means of the above 1st, A transmitting means which carries out wireless transmission of the signal of a mixed frequency ingredient of the above 1st by which wave filtration was carried out by a wave filtration means of the above 1st, A reception means which carries out radio receiving of the sending signal which has the predetermined radio frequency by which wireless transmission was modulated and carried out with the 2nd information signal in a distant office, and outputs an input signal, The 2nd signal generation means that generates the 2nd local oscillation signal that has predetermined frequency, An input signal which has nonlinear electrical and electric equipment and light transfer characteristics, and is outputted from the above-mentioned

reception means, and the 2nd local oscillation signal generated by the 2nd signal generation means of the above, So that the above-mentioned input signal and the 2nd local oscillation signal of the above may be mixed using electrical and electric equipment and the light transfer characteristics of the above-mentioned non-linearity and a signal of at least one mixed frequency ingredient between the above-mentioned input signal and the 2nd local oscillation signal of the above may arise. It has the 2nd electric light converting means that outputs electrical and electric equipment and the 2nd lightwave signal that carries out light conversion and includes a signal of the above-mentioned mixed frequency ingredient to the 2nd optical transmission line of the above, The 2nd light and electrical transducing means to which the above-mentioned main base station outputs further light and an electrical signal which carries out electrical conversion and includes a signal of the above-mentioned mixed frequency ingredient for the 2nd lightwave signal transmitted via the 2nd optical transmission line of the above from the 2nd electric light converting means of the above, The 2nd wave filtration means that carries out zone wave filtration of the signal of the 2nd mixed frequency ingredient beforehand decided among electrical signals outputted from light and an electrical transducing means of the above 2nd, It had a demodulation means which restores to a signal of a mixed frequency ingredient of the above 2nd by which wave filtration was carried out, and outputs the 2nd information signal of the above by a wave filtration means of the above 2nd.

[Claim 4]The lightwave transmission system for radio links according to claim 3, wherein wavelength multiplexing of the above 1st and the 2nd lightwave signal is carried out and they are transmitted via one optical transmission line.

[Claim 5]A lightwave transmission system for radio links provided with an optical transmission line which connects a main base station and \*\*\*\*\* in which only a predetermined distance separated and was provided from the above-mentioned main base station characterized by comprising the following, and the above-mentioned main base station and the above-mentioned \*\*\*\*\*.

A modulation means which modulates the above-mentioned main base station with an information signal into which a carrier signal which has predetermined frequency is inputted, and outputs a modulating signal.

A signal generation means which generates a local oscillation signal which has predetermined frequency.

While having nonlinear electrical and electric equipment and light transfer characteristics, answering a local oscillation signal generated by the above-mentioned signal generation means and generating at least one higher harmonic signal of the above-mentioned local oscillation signal using electrical and electric equipment and the light transfer characteristics of the above-mentioned non-linearity, A higher harmonic signal generated [ above-mentioned ] with a modulating signal outputted from the above-mentioned modulation means, So that a signal of at least one mixed frequency ingredient between higher harmonic signals which mixed a higher harmonic signal generated [ above-mentioned ] with the above-mentioned modulating signal using electrical and electric equipment and the light transfer characteristics of the above-mentioned non-linearity, and were generated [ above-mentioned ] with the above-mentioned modulating signal may arise. Have an electric light converting means which outputs electrical and electric equipment and a lightwave signal which carries out light conversion and includes a signal of the above-mentioned mixed frequency ingredient to the above-mentioned optical transmission line, and the above-mentioned \*\*\*\*\*, Light and an electrical transducing means which outputs light and an electrical signal which carries out electrical conversion and includes a signal of the above-mentioned mixed frequency ingredient for a lightwave signal transmitted via the above-mentioned optical transmission line from the above-mentioned electric light converting means

A wave filtration means which carries out zone wave filtration of the signal of one mixed frequency ingredient beforehand decided among electrical signals outputted from the above-mentioned light and electrical transducing means, and a transmitting means which carries out wireless transmission of the signal of the above-mentioned mixed frequency ingredient by which

wave filtration was carried out by the above-mentioned wave filtration means.

[Claim 6] A main base station.

The 1st which connects \*\*\*\*\* in which only a predetermined distance separated and was provided from the above-mentioned main base station, and the above-mentioned main base station and the above-mentioned \*\*\*\*\* , and the 2nd optical transmission line.

Are the above the lightwave transmission system for radio links which it had, and the above-mentioned main base station, A modulation means which modulates a carrier signal which has predetermined frequency with the 1st information signal into which it is inputted, and outputs a modulating signal, It has a signal generation means which generates a local oscillation signal which has predetermined frequency, and nonlinear electrical and electric equipment and light transfer characteristics, While answering a local oscillation signal generated by the above-mentioned signal generation means and generating at least one higher harmonic signal of the above-mentioned local oscillation signal using electrical and electric equipment and the light transfer characteristics of the above-mentioned non-linearity, A higher harmonic signal generated [ above-mentioned ] with a modulating signal outputted from the above-mentioned modulation means, So that a signal of at least one mixed frequency ingredient between higher harmonic signals which mixed a higher harmonic signal generated [ above-mentioned ] with the above-mentioned modulating signal using electrical and electric equipment and the light transfer characteristics of the above-mentioned non-linearity, and were generated [ above-mentioned ] with the above-mentioned modulating signal may arise. Have the 1st electric light converting means that outputs a higher harmonic signal generated [ above-mentioned ] by carrying out the electrical and electric equipment and light conversion, and the 1st lightwave signal including a signal of the above-mentioned mixed frequency ingredient to the 1st optical transmission line of the above, and the above-mentioned \*\*\*\*\* , The 1st light and electrical transducing means that outputs a higher harmonic signal generated [ above-mentioned ] by carrying out light and electrical conversion of the 1st lightwave signal transmitted via the 1st optical transmission line of the above from the 1st electric light converting means of the above, and an electrical signal including a signal of the above-mentioned mixed frequency ingredient, The 1st wave filtration means that carries out zone wave filtration of the signal of one mixed frequency ingredient beforehand decided among electrical signals outputted from light and an electrical transducing means of the above 1st, The 2nd wave filtration means that carries out zone wave filtration of the one higher harmonic signal beforehand decided among electrical signals outputted from light and an electrical transducing means of the above 1st, A transmitting means which carries out wireless transmission of the signal of the above-mentioned mixed frequency ingredient by which wave filtration was carried out by a wave filtration means of the above 1st, A reception means which carries out radio receiving of the sending signal which has the predetermined radio frequency by which wireless transmission was modulated and carried out with the 2nd information signal in a distant office, and outputs an input signal, The above-mentioned higher harmonic signal by which wave filtration was carried out by an input signal and a wave filtration means of the above 2nd which have nonlinear electrical and electric equipment and light transfer characteristics, and are outputted from the above-mentioned reception means, So that a signal of at least one mixed frequency ingredient between higher harmonic signals by which mixed a higher harmonic signal by which wave filtration was carried out [ above-mentioned ] to the above-mentioned input signal using electrical and electric equipment and the light transfer characteristics of the above-mentioned non-linearity, and wave filtration was carried out [ above-mentioned ] to the above-mentioned input signal may arise. It has the 2nd electric light converting means that outputs electrical and electric equipment and the 2nd lightwave signal that carries out light conversion and includes a signal of the above-mentioned mixed frequency ingredient to the 2nd optical transmission line of the above, The 2nd light and electrical transducing means to which the above-mentioned main base station outputs further light and an electrical signal which carries out electrical conversion and includes a signal of the above-mentioned mixed frequency ingredient for the 2nd lightwave signal transmitted via the 2nd optical transmission line of the above from the 2nd electric light converting means of the above,

The 3rd wave filtration means that carries out zone wave filtration of the signal of the 2nd mixed frequency ingredient beforehand decided among electrical signals outputted from light and an electrical transducing means of the above 2nd, It had a demodulation means which restores to a signal of a mixed frequency ingredient of the above 2nd by which wave filtration was carried out, and outputs the 2nd information signal of the above by a wave filtration means of the above 3rd.

[Claim 7]The lightwave transmission system for radio links according to claim 6, wherein wavelength multiplexing of the above 1st and the 2nd lightwave signal is carried out and they are transmitted via one optical transmission line.

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**DETAILED DESCRIPTION**

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[Detailed Description of the Invention]

[0001]

[Industrial Application]When the main base station which performs the strange recovery of a baseband signal, and \*\*\*\* provided with the transceiving equipment for transmitting and receiving via a terminal station and a wireless circuit are separated, this invention, About the lightwave transmission system for radio links for transmitting the signal (henceforth the signal for radio links) for transmitting and receiving via the above-mentioned wireless circuit using a fiber optic cable, It is related with the lightwave transmission system for radio links especially applicable to mobile communications systems, such as an automobile telephone system and a personal communication system.

[0002]

[Description of the Prior Art]In the conventional mobile communication system, in order to perform signal processing of a baseband signal in a base station, the equipment configuration of a base station becomes intricately and large-sized, and it is becoming difficult to install a base station in each of the microcell zone where the zone radius which needs many base stations is small, or a pico cell zone. In order to solve this problem, not forming the signal processor of a baseband signal in \*\*\*\* which covers a microcell zone or a pico cell zone, but forming only the transceiving equipment of only the analog signal processing about radio, and attaining simplification of a base station is proposed.

[0003]After modulating a subcarrier with the multiple signal specifically acquired by multiplexing a baseband signal in a main base station, for example, the modulating signal concerned is transmitted to \*\*\*\* via a wireless circuit or the wire circuit using a coaxial cable. And in \*\*\*\*, frequency conversion of the received modulating signal is carried out to a radio signal, and the radio signal concerned is turned to a moving terminal office, it transmits, and radio is performed.

[0004]

[Problem(s) to be Solved by the Invention]However, since it is necessary in this conventional system to set up many wireless circuits between a main base station and two or more \*\*\*\* when a main base station and \*\*\*\* are connected via a wireless circuit, While it became difficult to aim at effective use of an electric wave, there was a problem that it was necessary to avoid the problem of radio wave interference with the wireless circuits which connect a main base station and \*\*\*\*, and the wireless circuit which connects the wireless circuit concerned, \*\*\*\*, and moving terminal office.

[0005]In the above-mentioned conventional system, when a main base station and \*\*\*\* were connected via the wire circuit using a coaxial cable, there was a problem that the distance between that a maximum exists in carrier frequency for the line loss of the coaxial cable concerned and a main base station, and \*\*\*\* had restriction.

[0006]It is in the purpose of this invention providing the lightwave transmission system for radio links which solves the above problem, composition can be easy, can moreover connect a main base station and \*\*\*\* not using a wireless circuit as compared with a conventional example, and can transmit the signal for radio links.

[0007]

[Means for Solving the Problem]The lightwave transmission system for radio links according to claim 1 concerning this invention this invention, A lightwave transmission system for radio links provided with an optical transmission line which connects a main base station, \*\*\*\*\* in which only a predetermined distance separated and was provided from the above-mentioned main base station, and the above-mentioned main base station and the above-mentioned \*\*\*\*\* is characterized by comprising:

A modulation means which modulates the above-mentioned main base station with an information signal into which a carrier signal which has predetermined frequency is inputted, and outputs a modulating signal.

A signal generation means which generates a local oscillation signal which has predetermined frequency.

A modulating signal which has nonlinear electrical and electric equipment and light transfer characteristics, and is outputted from the above-mentioned modulation means, and a local oscillation signal generated by the above-mentioned signal generation means, So that the above-mentioned modulating signal and the above-mentioned local oscillation signal may be mixed using electrical and electric equipment and the light transfer characteristics of the above-mentioned non-linearity and a signal of at least one mixed frequency ingredient between the above-mentioned modulating signal and the above-mentioned local oscillation signal may arise. Have an electric light converting means which outputs electrical and electric equipment and a lightwave signal which carries out light conversion and includes a signal of the above-mentioned mixed frequency ingredient to the above-mentioned optical transmission line, and the above-mentioned \*\*\*\*\* , Light and an electrical transducing means which outputs light and an electrical signal which carries out electrical conversion and includes a signal of the above-mentioned mixed frequency ingredient for a lightwave signal transmitted via the above-mentioned optical transmission line from the above-mentioned electric light converting means an account of the upper by which wave filtration was carried out by wave filtration means which carries out zone wave filtration of the signal of a mixed frequency ingredient beforehand decided among electrical signals outputted from the above-mentioned light and electrical transducing means, and the above-mentioned wave filtration means — a transmitting means which carries out wireless transmission of the signal of a mixed frequency ingredient decided beforehand.

[0008]The lightwave transmission system for radio links according to claim 2 which this invention requires for this invention, A lightwave transmission system for radio links provided with an optical transmission line which connects a main base station, \*\*\*\*\* in which only a predetermined distance separated and was provided from the above-mentioned main base station, and the above-mentioned main base station and the above-mentioned \*\*\*\*\* is characterized by comprising:

A reception means which the above-mentioned \*\*\*\*\* carries out radio receiving of the sending signal which has the predetermined radio frequency by which wireless transmission was modulated and carried out with an information signal in a distant office, and outputs an input signal.

A signal generation means which generates a local oscillation signal which has predetermined frequency.

An input signal which has nonlinear electrical and electric equipment and light transfer characteristics, and is outputted from the above-mentioned reception means, and a local oscillation signal generated by the above-mentioned signal generation means, So that the above-mentioned input signal and the above-mentioned local oscillation signal may be mixed using electrical and electric equipment and the light transfer characteristics of the above-mentioned non-linearity and a signal of at least one mixed frequency ingredient between the above-mentioned input signal and the above-mentioned local oscillation signal may arise. Have an electric light converting means which outputs electrical and electric equipment and a lightwave signal which carries out light conversion and includes a signal of the above-mentioned mixed frequency ingredient to the above-mentioned optical transmission line, and the above-mentioned



main base station, Light and an electrical transducing means which outputs light and an electrical signal which carries out electrical conversion and includes a signal of the above-mentioned mixed frequency ingredient for a lightwave signal transmitted via the above-mentioned optical transmission line from the above-mentioned electric light converting means

A wave filtration means which carries out zone wave filtration of the signal of a mixed frequency ingredient beforehand decided among electrical signals outputted from the above-mentioned light and electrical transducing means, and a demodulation means which restores to a signal of the above-mentioned mixed frequency ingredient by which wave filtration was carried out, and outputs the above-mentioned information signal by the above-mentioned wave filtration means.

[0009]The lightwave transmission system for radio links according to claim 3 concerning this invention, A main base station and \*\*\*\*\* which only a predetermined distance separated and was provided from the above-mentioned main base station, Are the 1st which connects the above-mentioned main base station and the above-mentioned \*\*\*\*\* , and the 2nd optical transmission line the lightwave transmission system for radio links which it had, and the above-mentioned main base station, A modulation means which modulates a carrier signal which has predetermined frequency with the 1st information signal into which it is inputted, and outputs a modulating signal, The 1st signal generation means that generates the 1st local oscillation signal that has predetermined frequency, A modulating signal which has nonlinear electrical and electric equipment and light transfer characteristics, and is outputted from the above-mentioned modulation means, and the 1st local oscillation signal generated by the 1st signal generation means of the above, So that the above-mentioned modulating signal and the 1st local oscillation signal of the above may be mixed using electrical and electric equipment and the light transfer characteristics of the above-mentioned non-linearity and a signal of at least one mixed frequency ingredient between the above-mentioned modulating signal and the 1st local oscillation signal of the above may arise. Have the 1st electric light converting means that outputs electrical and electric equipment and the 1st lightwave signal that carries out light conversion and includes a signal of the above-mentioned mixed frequency ingredient to the 1st optical transmission line of the above, and the above-mentioned \*\*\*\*\* , The 1st light and electrical transducing means that outputs light and an electrical signal which carries out electrical conversion and includes a signal of the above-mentioned mixed frequency ingredient for the 1st lightwave signal transmitted via the 1st optical transmission line of the above from the 1st electric light converting means of the above, The 1st wave filtration means that carries out zone wave filtration of the signal of the 1st mixed frequency ingredient beforehand decided among electrical signals outputted from light and an electrical transducing means of the above 1st, A transmitting means which carries out wireless transmission of the signal of a mixed frequency ingredient of the above 1st by which wave filtration was carried out by a wave filtration means of the above 1st, A reception means which carries out radio receiving of the sending signal which has the predetermined radio frequency by which wireless transmission was modulated and carried out with the 2nd information signal in a distant office, and outputs an input signal, The 2nd signal generation means that generates the 2nd local oscillation signal that has predetermined frequency, and an input signal which has nonlinear electrical and electric equipment and light transfer characteristics, and is outputted from the above-mentioned reception means and the 2nd local oscillation signal generated by the 2nd signal generation means of the above, So that the above-mentioned input signal and the 2nd local oscillation signal of the above may be mixed using electrical and electric equipment and the light transfer characteristics of the above-mentioned non-linearity and a signal of at least one mixed frequency ingredient between the above-mentioned input signal and the 2nd local oscillation signal of the above may arise. It has the 2nd electric light converting means that outputs electrical and electric equipment and the 2nd lightwave signal that carries out light conversion and includes a signal of the above-mentioned mixed frequency ingredient to the 2nd optical transmission line of the above, The 2nd light and electrical transducing means to which the above-mentioned main base station outputs further light and an electrical signal which carries out electrical conversion and includes a signal of the above-mentioned mixed frequency

ingredient for the 2nd lightwave signal transmitted via the 2nd optical transmission line of the above from the 2nd electric light converting means of the above, The 2nd wave filtration means that carries out zone wave filtration of the signal of the 2nd mixed frequency ingredient beforehand decided among electrical signals outputted from light and an electrical transducing means of the above 2nd, It had a demodulation means which restores to a signal of a mixed frequency ingredient of the above 2nd by which wave filtration was carried out, and outputs the 2nd information signal of the above by a wave filtration means of the above 2nd.

[0010]In the lightwave transmission system for radio links according to claim 3, wavelength multiplexing of the above 1st and the 2nd lightwave signal is carried out, and the lightwave transmission system for radio links according to claim 4 is transmitted via one optical transmission line.

[0011]The lightwave transmission system for radio links according to claim 5 concerning this invention this invention, A lightwave transmission system for radio links provided with an optical transmission line which connects a main base station, \*\*\*\*\* in which only a predetermined distance separated and was provided from the above-mentioned main base station, and the above-mentioned main base station and the above-mentioned \*\*\*\*\* is characterized by comprising:

A modulation means which modulates the above-mentioned main base station with an information signal into which a carrier signal which has predetermined frequency is inputted, and outputs a modulating signal.

A signal generation means which generates a local oscillation signal which has predetermined frequency.

While having nonlinear electrical and electric equipment and light transfer characteristics, answering a local oscillation signal generated by the above-mentioned signal generation means and generating at least one higher harmonic signal of the above-mentioned local oscillation signal using electrical and electric equipment and the light transfer characteristics of the above-mentioned non-linearity, A higher harmonic signal generated [ above-mentioned ] with a modulating signal outputted from the above-mentioned modulation means, So that a signal of at least one mixed frequency ingredient between higher harmonic signals which mixed a higher harmonic signal generated [ above-mentioned ] with the above-mentioned modulating signal using electrical and electric equipment and the light transfer characteristics of the above-mentioned non-linearity, and were generated [ above-mentioned ] with the above-mentioned modulating signal may arise. Have an electric light converting means which outputs electrical and electric equipment and a lightwave signal which carries out light conversion and includes a signal of the above-mentioned mixed frequency ingredient to the above-mentioned optical transmission line, and the above-mentioned \*\*\*\*\* Light and an electrical transducing means which outputs light and an electrical signal which carries out electrical conversion and includes a signal of the above-mentioned mixed frequency ingredient for a lightwave signal transmitted via the above-mentioned optical transmission line from the above-mentioned electric light converting means

A wave filtration means which carries out zone wave filtration of the signal of one mixed frequency ingredient beforehand decided among electrical signals outputted from the above-mentioned light and electrical transducing means, and a transmitting means which carries out wireless transmission of the signal of the above-mentioned mixed frequency ingredient by which wave filtration was carried out by the above-mentioned wave filtration means.

[0012]The lightwave transmission system for radio links according to claim 6 concerning this invention, A main base station and \*\*\*\*\* which only a predetermined distance separated and was provided from the above-mentioned main base station, Are the 1st which connects the above-mentioned main base station and the above-mentioned \*\*\*\*\* and the 2nd optical transmission line the lightwave transmission system for radio links which it had, and the above-mentioned main base station, A modulation means which modulates a carrier signal which has predetermined frequency with the 1st information signal into which it is inputted, and outputs a modulating signal, It has a signal generation means which generates a local oscillation signal

which has predetermined frequency, and nonlinear electrical and electric equipment and light transfer characteristics, While answering a local oscillation signal generated by the above-mentioned signal generation means and generating at least one higher harmonic signal of the above-mentioned local oscillation signal using electrical and electric equipment and the light transfer characteristics of the above-mentioned non-linearity, A higher harmonic signal generated [ above-mentioned ] with a modulating signal outputted from the above-mentioned modulation means, So that a signal of at least one mixed frequency ingredient between higher harmonic signals which mixed a higher harmonic signal generated [ above-mentioned ] with the above-mentioned modulating signal using electrical and electric equipment and the light transfer characteristics of the above-mentioned non-linearity, and were generated [ above-mentioned ] with the above-mentioned modulating signal may arise. It has the 1st electric light converting means that outputs a higher harmonic signal generated [ above-mentioned ] by carrying out the electrical and electric equipment and light conversion, and the 1st lightwave signal including a signal of the above-mentioned mixed frequency ingredient to the 1st optical transmission line of the above, The 1st light and electrical transducing means that outputs a higher harmonic signal generated [ above-mentioned ] by the above-mentioned \*\*\*\*\* carrying out light and electrical conversion of the 1st lightwave signal transmitted via the 1st optical transmission line of the above from the 1st electric light converting means of the above, and an electrical signal including a signal of the above-mentioned mixed frequency ingredient, The 1st wave filtration means that carries out zone wave filtration of the signal of one mixed frequency ingredient beforehand decided among electrical signals outputted from light and an electrical transducing means of the above 1st, The 2nd wave filtration means that carries out zone wave filtration of the one higher harmonic signal beforehand decided among electrical signals outputted from light and an electrical transducing means of the above 1st, A transmitting means which carries out wireless transmission of the signal of the above-mentioned mixed frequency ingredient by which wave filtration was carried out by a wave filtration means of the above 1st, A reception means which carries out radio receiving of the sending signal which has the predetermined radio frequency by which wireless transmission was modulated and carried out with the 2nd information signal in a distant office, and outputs an input signal, The above-mentioned higher harmonic signal by which wave filtration was carried out by an input signal and a wave filtration means of the above 2nd which have nonlinear electrical and electric equipment and light transfer characteristics, and are outputted from the above-mentioned reception means, So that a signal of at least one mixed frequency ingredient between higher harmonic signals by which mixed a higher harmonic signal by which wave filtration was carried out [ above-mentioned ] to the above-mentioned input signal using electrical and electric equipment and the light transfer characteristics of the above-mentioned non-linearity, and wave filtration was carried out [ above-mentioned ] to the above-mentioned input signal may arise. It has the 2nd electric light converting means that outputs electrical and electric equipment and the 2nd lightwave signal that carries out light conversion and includes a signal of the above-mentioned mixed frequency ingredient to the 2nd optical transmission line of the above, The 2nd light and electrical transducing means to which the above-mentioned main base station outputs further light and an electrical signal which carries out electrical conversion and includes a signal of the above-mentioned mixed frequency ingredient for the 2nd lightwave signal transmitted via the 2nd optical transmission line of the above from the 2nd electric light converting means of the above, The 3rd wave filtration means that carries out zone wave filtration of the signal of the 2nd mixed frequency ingredient beforehand decided among electrical signals outputted from light and an electrical transducing means of the above 2nd, It had a demodulation means which restores to a signal of a mixed frequency ingredient of the above 2nd by which wave filtration was carried out, and outputs the 2nd information signal of the above by a wave filtration means of the above 3rd.

[0013]In the lightwave transmission system for radio links according to claim 6, wavelength multiplexing of the above 1st and the 2nd lightwave signal is carried out, and the lightwave transmission system for radio links according to claim 7 is transmitted via one optical transmission line.

[0014]

[Function] In the lightwave transmission system for radio links given in above-mentioned claim 1, in the above-mentioned main base station, the above-mentioned modulation means modulates the carrier signal which has predetermined frequency with the information signal into which it is inputted, and outputs a modulating signal, and, on the other hand, the above-mentioned signal generation means generates the local oscillation signal which has predetermined frequency. Subsequently, the above-mentioned electric light converting means has nonlinear electrical and electric equipment and light transfer characteristics, The modulating signal outputted from the above-mentioned modulation means, and the local oscillation signal generated by the above-mentioned signal generation means, The electrical and electric equipment and the lightwave signal which carries out light conversion and includes the signal of the above-mentioned mixed frequency ingredient are outputted to the above-mentioned optical transmission line so that the above-mentioned modulating signal and the above-mentioned local oscillation signal may be mixed using the electrical and electric equipment and the light transfer characteristics of the above-mentioned non-linearity and the signal of at least one mixed frequency ingredient between the above-mentioned modulating signal and the above-mentioned local oscillation signal may arise. On the other hand in the above-mentioned \*\*\*\*\*, the above-mentioned light and electrical transducing means, After outputting light and the electrical signal which carries out electrical conversion and includes the signal of the above-mentioned mixed frequency ingredient for the lightwave signal transmitted via the above-mentioned optical transmission line from the above-mentioned electric light converting means, the above-mentioned wave filtration means carries out zone wave filtration of the signal of the mixed frequency ingredient beforehand decided among the electrical signals outputted from the above-mentioned light and electrical transducing means. subsequently, the account of the upper to which wave filtration of the above-mentioned transmitting means was carried out by the above-mentioned wave filtration means — wireless transmission of the signal of the mixed frequency ingredient decided beforehand is carried out.

[0015] In the lightwave transmission system for radio links according to claim 1 constituted as mentioned above, since the above-mentioned main base station and the above-mentioned \*\*\*\*\* are connected using the above-mentioned optical transmission line, the radio wave interference to the wireless circuit set up between the above-mentioned \*\*\*\*\* and a terminal station from the radio-link system concerned can be lost. Since the radio frequency in the wireless circuit set up between the above-mentioned \*\*\*\*\* and the above-mentioned terminal station by setting up suitably the carrier frequency of the above-mentioned information signal and the frequency of the above-mentioned local oscillation signal by the above-mentioned main base station side can be set up arbitrarily, For example, the radio frequency in two or more microcell zones formed of two or more \*\*\*\*\*, respectively can be set up easily. Hereafter, this is called 1st operation effect. In the above-mentioned \*\*\*\*\*, since it does not have the signal processor of the above-mentioned information signal, the composition of the above-mentioned \*\*\*\*\* can be miniaturized and economized, and the \*\*\*\*\* concerned can be installed in a smaller space. Therefore, it becomes possible to install many walkie-talkies for each radio channel in each microcell zone by the predetermined installing space of the above-mentioned \*\*\*\*\* . Hereafter, this is called 2nd operation effect. The stability of the frequency of the sending signal transmitted from the above-mentioned \*\*\*\*\*, Since it is determined by the stability of the frequency of the carrier signal of the modulating signal inputted into the above-mentioned electric light converting means, and the stability of the frequency of the above-mentioned local oscillation signal, By raising the stability of the carrier frequency of the carrier wave signal generator in the above-mentioned main base station, and the stability of the oscillating frequency of a local oscillation signal generator, the stability of the frequency of the sending signal in a wireless circuit can be raised easily. Hereafter, this is called 3rd operation effect.

[0016] In the lightwave transmission system for radio links given in above-mentioned claim 2, In the above-mentioned \*\*\*\*\*, the above-mentioned reception means carries out radio receiving of the sending signal which has the predetermined radio frequency by which wireless transmission was modulated and carried out with the information signal in the distant office, and

outputs an input signal, and, on the other hand, the above-mentioned signal generation means generates the local oscillation signal which has predetermined frequency. Subsequently, the above-mentioned electric light converting means has nonlinear electrical and electric equipment and light transfer characteristics, The input signal outputted from the above-mentioned reception means, and the local oscillation signal generated by the above-mentioned signal generation means, The electrical and electric equipment and the lightwave signal which carries out light conversion and includes the signal of the above-mentioned mixed frequency ingredient are outputted to the above-mentioned optical transmission line so that the above-mentioned input signal and the above-mentioned local oscillation signal may be mixed using the electrical and electric equipment and the light transfer characteristics of the above-mentioned non-linearity and the signal of at least one mixed frequency ingredient between the above-mentioned input signal and the above-mentioned local oscillation signal may arise. On the other hand in the above-mentioned main base station, the above-mentioned light and electrical transducing means, After outputting light and the electrical signal which carries out electrical conversion and includes the signal of the above-mentioned mixed frequency ingredient for the lightwave signal transmitted via the above-mentioned optical transmission line from the above-mentioned electric light converting means, the above-mentioned wave filtration means carries out zone wave filtration of the signal of the mixed frequency ingredient beforehand decided among the electrical signals outputted from the above-mentioned light and electrical transducing means. Subsequently, by the above-mentioned wave filtration means, the above-mentioned demodulation means restores to the signal of the above-mentioned mixed frequency ingredient by which wave filtration was carried out, and outputs the above-mentioned information signal. The lightwave transmission system for radio links according to claim 2 constituted as mentioned above has the above 1st and the 2nd operation effect.

[0017]In the lightwave transmission system for radio links given in above-mentioned claim 3, In the above-mentioned main base station, the above-mentioned modulation means modulates the carrier signal which has predetermined frequency with the 1st information signal into which it is inputted, and outputs a modulating signal, and, on the other hand, the 1st signal generation means of the above generates the 1st local oscillation signal that has predetermined frequency. Subsequently, the 1st electric light converting means of the above has nonlinear electrical and electric equipment and light transfer characteristics, The modulating signal outputted from the above-mentioned modulation means, and the 1st local oscillation signal generated by the 1st signal generation means of the above, So that the above-mentioned modulating signal and the 1st local oscillation signal of the above may be mixed using the electrical and electric equipment and the light transfer characteristics of the above-mentioned non-linearity and the signal of at least one mixed frequency ingredient between the above-mentioned modulating signal and the 1st local oscillation signal of the above may arise. The electrical and electric equipment and the 1st lightwave signal that carries out light conversion and includes the signal of the above-mentioned mixed frequency ingredient are outputted to the 1st optical transmission line of the above. On the other hand in the above-mentioned \*\*\*\*\*, the light and the electrical transducing means of the above 1st, After outputting light and the electrical signal which carries out electrical conversion and includes the signal of the above-mentioned mixed frequency ingredient for the 1st lightwave signal transmitted via the 1st optical transmission line of the above from the 1st electric light converting means of the above, The wave filtration means of the above 1st carries out zone wave filtration of the signal of the 1st mixed frequency ingredient beforehand decided among the electrical signals outputted from the light and the electrical transducing means of the above 1st. Subsequently, the above-mentioned transmitting means carries out wireless transmission of the signal of the mixed frequency ingredient of the above 1st by which wave filtration was carried out by the wave filtration means of the above 1st. The above-mentioned reception means carries out radio receiving of the sending signal which has the predetermined radio frequency by which wireless transmission was modulated and carried out with the 2nd information signal in the distant office, and outputs an input signal, and, on the other hand, the 2nd signal generation means of the above generates the 2nd local oscillation signal that has predetermined frequency. Subsequently, the 2nd electric light converting means

of the above has nonlinear electrical and electric equipment and light transfer characteristics, The input signal outputted from the above-mentioned reception means, and the 2nd local oscillation signal generated by the 2nd signal generation means of the above, So that the above-mentioned input signal and the 2nd local oscillation signal of the above may be mixed using the electrical and electric equipment and the light transfer characteristics of the above-mentioned non-linearity and the signal of at least one mixed frequency ingredient between the above-mentioned input signal and the 2nd local oscillation signal of the above may arise. The electrical and electric equipment and the 2nd lightwave signal that carries out light conversion and includes the signal of the above-mentioned mixed frequency ingredient are outputted to the 2nd optical transmission line of the above. In the above-mentioned main base station, the light and the electrical transducing means of the above 2nd, After outputting light and the electrical signal which carries out electrical conversion and includes the signal of the above-mentioned mixed frequency ingredient for the 2nd lightwave signal transmitted via the 2nd optical transmission line of the above from the 2nd electric light converting means of the above, The wave filtration means of the above 2nd carries out zone wave filtration of the signal of the 2nd mixed frequency ingredient beforehand decided among the electrical signals outputted from the light and the electrical transducing means of the above 2nd. Subsequently, by the wave filtration means of the above 2nd, the above-mentioned demodulation means restores to the signal of the mixed frequency ingredient of the above 2nd by which wave filtration was carried out, and outputs the 2nd information signal of the above. The lightwave transmission system for radio links according to claim 3 constituted as mentioned above has the above 1st thru/or the 3rd operation effect. [0018]In the lightwave transmission system for radio links according to claim 3, preferably, wavelength multiplexing of the above 1st and the 2nd lightwave signal is carried out, and the lightwave transmission system for radio links given in above-mentioned claim 4 is transmitted via one optical transmission line.

[0019]In the lightwave transmission system for radio links given in above-mentioned claim 5, in the above-mentioned main base station, the above-mentioned modulation means modulates the carrier signal which has predetermined frequency with the information signal into which it is inputted, and outputs a modulating signal, and, on the other hand, the above-mentioned signal generation means generates the local oscillation signal which has predetermined frequency. Subsequently, the above-mentioned electric light converting means has nonlinear electrical and electric equipment and light transfer characteristics, While answering the local oscillation signal generated by the above-mentioned signal generation means and generating at least one higher harmonic signal of the above-mentioned local oscillation signal using the electrical and electric equipment and the light transfer characteristics of the above-mentioned non-linearity, The higher harmonic signal generated [ above-mentioned ] with the modulating signal outputted from the above-mentioned modulation means, So that the signal of at least one mixed frequency ingredient between the higher harmonic signals which mixed the higher harmonic signal generated [ above-mentioned ] with the above-mentioned modulating signal using the electrical and electric equipment and the light transfer characteristics of the above-mentioned non-linearity, and were generated [ above-mentioned ] with the above-mentioned modulating signal may arise. The electrical and electric equipment and the lightwave signal which carries out light conversion and includes the signal of the above-mentioned mixed frequency ingredient are outputted to the above-mentioned optical transmission line. On the other hand in the above-mentioned \*\*\*\*\*, the above-mentioned light and electrical transducing means, After outputting light and the electrical signal which carries out electrical conversion and includes the signal of the above-mentioned mixed frequency ingredient, the above-mentioned wave filtration means the lightwave signal transmitted via the above-mentioned optical transmission line from the above-mentioned electric light converting means, Zone wave filtration of the signal of one mixed frequency ingredient beforehand decided among the electrical signals outputted from the above-mentioned light and electrical transducing means is carried out. Subsequently, the above-mentioned transmitting means carries out wireless transmission of the signal of the above-mentioned mixed frequency ingredient by which wave filtration was carried out by the above-mentioned wave filtration means. The lightwave transmission system for radio links according to claim 5

constituted as mentioned above has the above 1st thru/or the 3rd operation effect.

[0020] In the lightwave transmission system for radio links given in above-mentioned claim 6, In the above-mentioned main base station, the above-mentioned modulation means modulates the carrier signal which has predetermined frequency with the 1st information signal into which it is inputted, and outputs a modulating signal, and, on the other hand, the above-mentioned signal generation means generates the local oscillation signal which has predetermined frequency. Subsequently, the 1st electric light converting means of the above has nonlinear electrical and electric equipment and light transfer characteristics, While answering the local oscillation signal generated by the above-mentioned signal generation means and generating at least one higher harmonic signal of the above-mentioned local oscillation signal using the electrical and electric equipment and the light transfer characteristics of the above-mentioned non-linearity, The higher harmonic signal generated [ above-mentioned ] with the modulating signal outputted from the above-mentioned modulation means, So that the signal of at least one mixed frequency ingredient between the higher harmonic signals which mixed the higher harmonic signal generated [ above-mentioned ] with the above-mentioned modulating signal using the electrical and electric equipment and the light transfer characteristics of the above-mentioned non-linearity, and were generated [ above-mentioned ] with the above-mentioned modulating signal may arise. The higher harmonic signal generated [ above-mentioned ] by carrying out the electrical and electric equipment and light conversion and the 1st lightwave signal including the signal of the above-mentioned mixed frequency ingredient are outputted to the 1st optical transmission line of the above. On the other hand in the above-mentioned \*\*\*\*\*, the light and the electrical transducing means of the above 1st, After outputting the higher harmonic signal generated [ above-mentioned ] by carrying out light and electrical conversion of the 1st lightwave signal transmitted via the 1st optical transmission line of the above from the 1st electric light converting means of the above, and an electrical signal including the signal of the above-mentioned mixed frequency ingredient, The wave filtration means of the above 1st carries out zone wave filtration of the signal of one mixed frequency ingredient beforehand decided among the electrical signals outputted from the light and the electrical transducing means of the above 1st, and the wave filtration means of the above 2nd, Zone wave filtration of the one higher harmonic signal beforehand decided among the electrical signals outputted from the light and the electrical transducing means of the above 1st is carried out. Subsequently, the above-mentioned transmitting means carries out wireless transmission of the signal of the above-mentioned mixed frequency ingredient by which wave filtration was carried out by the wave filtration means of the above 1st. After the above-mentioned reception means's carrying out radio receiving of the sending signal which has the predetermined radio frequency by which wireless transmission was modulated and carried out with the 2nd information signal in the distant office and outputting an input signal, The 2nd electric light converting means of the above has nonlinear electrical and electric equipment and light transfer characteristics, The above-mentioned higher harmonic signal by which wave filtration was carried out by the input signal and the wave filtration means of the above 2nd which are outputted from the above-mentioned reception means, So that the signal of at least one mixed frequency ingredient between the higher harmonic signals by which mixed the higher harmonic signal by which wave filtration was carried out [ above-mentioned ] to the above-mentioned input signal using the electrical and electric equipment and the light transfer characteristics of the above-mentioned non-linearity, and wave filtration was carried out [ above-mentioned ] to the above-mentioned input signal may arise. The electrical and electric equipment and the 2nd lightwave signal that carries out light conversion and includes the signal of the above-mentioned mixed frequency ingredient are outputted to the 2nd optical transmission line of the above. In the above-mentioned main base station, the light and the electrical transducing means of the above 2nd, After outputting light and the electrical signal which carries out electrical conversion and includes the signal of the above-mentioned mixed frequency ingredient for the 2nd lightwave signal transmitted via the 2nd optical transmission line of the above from the 2nd electric light converting means of the above, The wave filtration means of the above 3rd carries out zone wave filtration of the signal of the 2nd mixed frequency ingredient beforehand decided among the electrical signals outputted from the light and the



electrical transducing means of the above 2nd. Subsequently, by the wave filtration means of the above 3rd, the above-mentioned demodulation means restores to the signal of the mixed frequency ingredient of the above 2nd by which wave filtration was carried out, and outputs the 2nd information signal of the above.

[0021]The lightwave transmission system for radio links according to claim 6 constituted as mentioned above has the above 1st thru/or the 3rd operation effect. Since the above-mentioned higher harmonic signal acquired from the above-mentioned main base station by carrying out light and electrical conversion of the transmitted lightwave signal for the frequency conversion of the received radio signal is used as a local oscillation signal, The composition of the above-mentioned \*\*\*\*\* can be simplified as compared with the case where the generator made to generate a local oscillation signal in the above-mentioned \*\*\*\*\* is formed, and a miniaturization and economization of the above-mentioned \*\*\*\*\* can be attained by this. Since the harmonic content of the local oscillation signal generated in the above-mentioned main base station is used as a local oscillation signal in the above 1st and the 2nd electric light converting means, the flexibility of setting out of the transmission and reception frequency of the wireless circuit between the above-mentioned \*\*\*\*\* and the above-mentioned terminal station can be increased as compared with a conventional example.

[0022]In the lightwave transmission system for radio links according to claim 6, preferably, wavelength multiplexing of the above 1st and the 2nd lightwave signal is carried out, and the lightwave transmission system for radio links according to claim 7 is transmitted via one optical transmission line.

[0023]

[Example]Hereafter, the example which starts this invention with reference to drawings is described.

[0024]<1st example> drawing 1 is a block diagram of the lightwave transmission system for radio links which is the 1st example concerning this invention.

[0025]The lightwave transmission system for radio links of this 1st example, The main base station 100 and \*\*\*\*\* 200 which only a predetermined distance separated and was provided from the main base station 100, Two fiber optic cable FC1 for connecting the main base station 100 and \*\*\*\*\* 200, and FC2, It comprises the moving terminal office 300 connected with \*\*\*\*\* 200 via a wireless circuit, After compounding the FM signal and local oscillation signal which are acquired by carrying out FM modulation with the baseband signal (it abbreviates to BB signal in a drawing hereafter.) into which a carrier signal is inputted from an external device, The FM signal by which carried out light modulation of the composite signal using the laser diode 13 which has nonlinear electrical and electric equipment and light transfer characteristics, and frequency conversion was carried out to the radio frequency. (it is hereafter called a radio FM signal.), while changing into the 1st lightwave signal to include and transmitting the 1st lightwave signal concerned to \*\*\*\*\* 200 via fiber optic cable FC1, In \*\*\*\*\* 200, after amplifying the radio FM signal by which zone wave filtration was carried out [ FM signal / above-mentioned / radio ] by carrying out zone wave filtration with the band-pass filter 31 after light and electrical conversion in the 1st lightwave signal, it transmits to the moving terminal office 300.

[0026]After amplifying the radio FM signal received from the moving terminal office 300 in \*\*\*\*\* 200, The FM signal by which compounded with the local oscillation signal, carried out light modulation of the composite signal concerned using the laser diode 37 which has nonlinear electrical and electric equipment and light transfer characteristics, and frequency conversion was carried out to lower frequency. (it is hereafter called a low-pass conversion FM signal.) — it changing into the 2nd lightwave signal to include, and the 2nd lightwave signal concerned being transmitted to the main base station 100 via fiber optic cable FC2, and in the main base station 100, Light and after carrying out electrical conversion, zone wave filtration of the above-mentioned low-pass conversion FM signal is carried out for the 2nd lightwave signal with the band-pass filter 21, FM recovery of the low-pass conversion FM signal which carried out zone wave filtration is carried out, and a baseband signal is outputted.

[0027]As shown in drawing 1, the main base station 100 is provided with FM modulator 10, the



local oscillation signal generator 11, the composing device 12, the laser diode 13, the photodetector 20, the band-pass filter 21, and FM demodulator 22. On the other hand, \*\*\*\*\* 200 is provided with the photodetector 30, the band-pass filter 31, the transmit power amplifier 32, the antenna shared device 33, the transmitting antennas 40, the head amplifier 34, the composing device 35, the local oscillation signal generator 36, and the laser diode 37.

[0028]In the main base station 100, after carrying out FM modulation of FM modulator 10 with the baseband signal into which the carrier signal of the frequency  $f_s$  is inputted from an external device, it outputs the FM signal after FM modulation to the composing device 12. The composing device 12 compounds the FM signal inputted and the local oscillation signal of the sine wave of the frequency  $f_l$  ( $f_l > f_s$ ) generated with the local oscillation signal generator 11, and outputs the composite signal concerned to the laser diode 13. The laser diode 13 has nonlinear electrical and electric equipment and light transfer characteristics, and the electrical and electric equipment and light conversion carry out the composite signal inputted using the above-mentioned transfer characteristic. The lightwave signal after the conversion concerned by which intensity modulation was carried out with the above-mentioned composite signal is outputted to fiber optic cable FC1, and the lightwave signal concerned is transmitted to the photodetector 30 in \*\*\*\*\* 200 by this via fiber optic cable FC1. Since the laser diode 13 has the electrical and electric equipment and light transfer characteristics nonlinear as mentioned above, here the lightwave signal concerned, Electrical signals, such as an FM signal of the carrier frequency  $f_s$ , a local oscillation signal of the frequency  $f_l$ , an FM signal (henceforth a radio FM signal) of frequency  $(f_l + f_s)$ , and an FM signal of frequency  $(f_l - f_s)$ , are included.

[0029]Detect the lightwave signal which the photodetector 30 was transmitted via fiber optic cable FC1, and was inputted in \*\*\*\*\* 200, and Light, after carrying out electrical conversion, The electrical signal after the conversion concerned is outputted to the transmit power amplifier 32 via the band-pass filter 31 which mainly passes only the radio FM signal ingredient of frequency  $(f_l + f_s)$ . The transmit power amplifier 32 carries out power amplification of the inputted radio FM signal of frequency  $(f_l + f_s)$ , outputs it to the transmitting antennas 40 via the antenna shared device 33, and the radio FM signal concerned is turned to the transmitting antennas 41 of the moving terminal office 300, and it carries out wireless transmission.

[0030]In the laser diode 13 of the main base station 100 here the FM signal of the carrier frequency  $f_s$ , Rise conversion can be carried out to the radio FM signal of higher frequency using the local oscillation signal of the frequency  $f_l$  which was both compounded and was inputted, By carrying out zone wave filtration of the radio FM signal after frequency conversion with the band-pass filter 31 of \*\*\*\*\* 200, the radio FM signal concerned can be used as a transmitting radio signal to the moving terminal office 300. That is, the laser diode 13 is used not only as the electrical and electric equipment and a light-transforming element but as a mixer for high frequency. Therefore, the radio FM signal which has a predetermined radio frequency used as the above-mentioned transmitting radio signal can be easily generated by setting up suitably the carrier frequency  $f_s$  and the frequency  $f_l$  of a local oscillation signal.

[0031]On the other hand, the radio FM signal of frequency  $(f_l + f_s + f_d)$  transmitted towards the transmitting antennas 40 of \*\*\*\*\* 200 from the transmitting antennas 41 of the moving terminal office 300 is inputted into the composing device 35 via the antenna shared device 33 and the head amplifier 34, after being received by the transmitting antennas 40. Here, the radio FM signal transmitted from the moving terminal office 300 is a signal acquired by carrying out frequency conversion of the carrier signal of the frequency  $f_s$  to the above-mentioned radio frequency  $(f_l + f_s + f_d)$  after FM modulation is carried out with a baseband signal.

The frequency  $f_d$  is a transmission-and-reception-frequency interval in the wireless circuit of \*\*\*\*\* 200 and the moving terminal office 300.

The composing device 35 compounds the inputted radio FM signal and the local oscillation signal of frequency  $(f_l + f_d)$  generated and inputted with the local oscillation signal generator 36, and outputs the composite signal concerned to the laser diode 37. The laser diode 37 has nonlinear electrical and electric equipment and light transfer characteristics, and the electrical and electric equipment and light conversion carry out the composite signal inputted using the above-mentioned transfer characteristic. The lightwave signal after the conversion concerned by which

intensity modulation was carried out with the above-mentioned composite signal is outputted to fiber optic cable FC2, and the lightwave signal concerned is transmitted to the photodetector 20 in the main base station 100 by this via fiber optic cable FC2. Since the laser diode 37 has the electrical and electric equipment and light transfer characteristics nonlinear as mentioned above, here the lightwave signal concerned, The radio FM signal of frequency  $(f_l + f_s + f_d)$ , and the local oscillation signal of frequency  $(f_l + f_d)$ , Electrical signals, such as an FM signal of frequency  $\{(f_l + f_s + f_d) - (f_l + f_d) = f_s\}$  and a radio FM signal of frequency  $\{(f_l + f_s + f_d) + (f_l + f_d) = 2f_l + f_s + 2f_d\}$ , are included.

[0032] Detect the lightwave signal which the photodetector 20 was transmitted via fiber optic cable FC2, and was inputted in the main base station 100, and Light, after carrying out electrical conversion, The electrical signal after the conversion concerned is outputted to FM demodulator 22 via the band-pass filter 21 which mainly passes only the FM signal ingredient of the frequency  $f_s$ . FM demodulator 22 processes FM recovery to the inputted FM signal, and restores to it and outputs a baseband signal.

[0033] Here the radio FM signal of frequency  $(f_l + f_s + f_d)$ , Down conversion can be carried out to the FM signal of lower frequency using the local oscillation signal of frequency  $(f_l + f_d)$  which was both compounded and was inputted in the laser diode 37 of \*\*\*\*\* 200, After carrying out zone wave filtration of the FM signal after frequency conversion with the band-pass filter 21 of the main base station 100, a baseband signal can be acquired by carrying out FM recovery. That is, the laser diode 37 is used not only as the electrical and electric equipment and a light-transforming element but as a mixer for high frequency.

[0034] Drawing 4 is a graph which shows the example of the characteristic of the power level of the electrical signal included in the lightwave signal over the power level of the electrical signal inputted outputted in the laser diode 13 of the main base station 100 of the 1st example. Each preset value at the time of measurement of this characteristic is as follows.

Frequency  $f_s$  of the carrier signal inputted = frequency  $f_l = 4\text{GHz}$  of the local oscillation signal inputted 0.9 GHz, bias current  $I_d = 35\text{mA}$  of the laser diode 13 [0035] It turns out that it is contained in the lightwave signal outputted from the laser diode 13, and the signal of frequency  $(f_l + f_s)$  and the signal of frequency  $(f_l - f_s)$  are included after frequency conversion as an electrical signal outputted from the photodetector 30 so that clearly from drawing 4.

[0036] In the lightwave transmission system for radio links of the 1st example constituted as mentioned above, Since the main base station 100 and \*\*\*\*\* 200 are connected using fiber optic cable FC1 and FC2, the radio wave interference to the wireless circuit set up between \*\*\*\*\* 200 and the moving terminal office 300 from the radio-link system concerned can be lost. Since the radio frequency in the wireless circuit set up between \*\*\*\*\* 200 and the moving terminal office 300 by setting up suitably the carrier frequency  $f_s$  and the local oscillation frequency  $f_l$  by the main base station 100 side can be set up arbitrarily, For example, there is an advantage that the radio frequency in two or more microcell zones formed of two or more \*\*\*\*\* 200, respectively can be set up easily.

[0037] In \*\*\*\*\* 200, since it does not have the signal processor of a baseband signal, the composition of \*\*\*\*\* 200 concerned can be miniaturized and economized, and \*\*\*\*\* 200 concerned can be installed in a smaller space. Therefore, it becomes possible to install many walkie-talkies for each radio channel in each microcell zone by the predetermined installing space of \*\*\*\*\* 200.

[0038] The stability of the frequency of the radio FM signal transmitted from \*\*\*\*\* 200, Since it is determined by the stability of the frequency  $f_s$  of the carrier signal generated within FM modulator 10, and the stability of the local oscillation signal of the frequency  $f_l$  generated with the local oscillation signal generator 11, By raising the stability of the oscillating frequency of the carrier wave signal generator in FM modulator 10 in the main base station 100, and the stability of the oscillating frequency of the local oscillation signal generator 11, the stability of the frequency of the high frequency signal easily used as a sending signal in a wireless circuit can be raised.

[0039] In the above example [ 1st ], although only one \*\*\*\*\* 200 and the one moving terminal office 300 are shown, not only this but \*\*\*\*\* 200 and two or more moving terminal offices

300 of plurality respectively may be provided.

[0040]<2nd example> drawing 2 is a block diagram of the lightwave transmission system for radio links which is the 2nd example concerning this invention.

[0041]The lightwave transmission system for radio links of this 2nd example, In [ have the main base station 101 and \*\*\*\*\* 201, and ] the laser diode 13t in the main base station 101 as compared with the 1st example, While generating the 2nd higher harmonic signal of the local oscillation signal of frequency  $2f_l$  using nonlinear its electrical and electric equipment and light transfer characteristics, In [ mix the 2nd higher harmonic signal concerned and FM signal of the carrier frequency  $f_s$ , generate the radio FM signal of frequency  $(2f_l + f_s)$ , transmit a lightwave signal including these electrical signals to \*\*\*\*\* 201, and ] \*\*\*\*\* 201, While carrying out zone wave filtration of the radio FM signal of frequency  $(2f_l + f_s)$  and using it as a transmitting radio signal to the moving terminal office 300 with the band-pass filter 38, It is characterized by carrying out zone wave filtration of the 2nd higher harmonic signal of the above-mentioned local oscillation signal with the band-pass filter 39, and using the radio FM signal which received the 2nd harmonics of the above-mentioned local oscillation signal concerned which carried out zone wave filtration as a local oscillation signal for carrying out down conversion. Hereafter, a point of difference with the 1st example is explained.

[0042]The laser diode 13t has nonlinear electrical and electric equipment and light transfer characteristics, and, in the electrical and electric equipment and light conversion, the FM signal of the carrier frequency  $f_s$  and the local oscillation signal of the frequency  $f_l$  carry out the composite signal compounded and inputted using the above-mentioned transfer characteristic, The lightwave signal after the conversion concerned by which intensity modulation was carried out with the above-mentioned composite signal is outputted to fiber optic cable FC1, and the lightwave signal concerned is transmitted to the photodetector 30 in \*\*\*\*\* 201 by this via fiber optic cable FC1. Here, the bias voltage and the signal level of the composite signal inputted are adjusted so that the signal level of the 2nd higher harmonic signal of the local oscillation signal within the electrical signal with which the laser diode 13t is contained in the above-mentioned lightwave signal may serve as the maximum in general. Since the laser diode 13t has the electrical and electric equipment and light transfer characteristics nonlinear as mentioned above, the lightwave signal which is a basis of this state and is outputted from the laser diode 13t, The FM signal of the carrier frequency  $f_s$ , the local oscillation signal of the frequency  $f_l$ , and the 2nd higher harmonic signal of the local oscillation signal of frequency  $(2f_l)$ , Electrical signals, such as an FM signal of frequency  $(f_l + f_s)$ , an FM signal of frequency  $(f_l - f_s)$ , an FM signal (henceforth a radio FM signal) of frequency  $(2f_l + f_s)$ , and an FM signal of frequency  $(2f_l - f_s)$ , are included.

[0043]Detect the lightwave signal which the photodetector 30 was transmitted via fiber optic cable FC1, and was inputted in \*\*\*\*\* 201, and Light, after carrying out electrical conversion, While outputting the electrical signal after the conversion concerned to the transmit power amplifier 32 via the band-pass filter 38 which mainly passes only the radio FM signal ingredient of frequency  $(2f_l + f_s)$ , It outputs to the composing device 35 via the band-pass filter 39 which mainly passes only the 2nd higher harmonic signal component of the local oscillation signal of frequency  $2f_l$ . The transmit power amplifier 32 carries out power amplification of the inputted radio FM signal of frequency  $(2f_l + f_s)$ , outputs it to the transmitting antennas 40 via the antenna shared device 33, and the radio FM signal concerned is turned to the transmitting antennas 41 of the moving terminal office 300, and it carries out wireless transmission.

[0044]Rise conversion of both the FM signals of the carrier frequency  $f_s$  can be carried out to the radio FM signal of higher frequency here using the 2nd higher harmonic signal of the local oscillation signal compounded and inputted in the laser diode 13t of the main base station 101, By carrying out zone wave filtration of the radio FM signal after frequency conversion with the band-pass filter 38 of \*\*\*\*\* 201, the radio FM signal concerned can be used as a transmitting radio signal to the moving terminal office 300. That is, the laser diode 13t is used as the harmonic generator and the mixer for high frequency of the electrical and electric equipment and not only a light-transforming element but a local oscillation signal. Therefore, the radio FM signal used as the above-mentioned transmitting radio signal can be easily generated by setting

up suitably the carrier frequency  $f_s$  and the frequency  $f_l$  of a local oscillation signal.

[0045]After the radio FM signal of frequency  $[2f_l + f_s'; f_s' = f_s + f_d$  (transmission-and-reception-frequency interval)] transmitted towards the transmitting antennas 40 of \*\*\*\*\* 201 from the transmitting antennas 41 of the moving terminal office 300 was received by the transmitting antennas 40 on the other hand, It is inputted into the composing device 35 via the antenna shared device 33 and the head amplifier 34. Here, the radio FM signal transmitted from the moving terminal office 300 is a signal acquired by carrying out frequency conversion of the carrier signal of frequency  $f_s'$  to the above-mentioned radio frequency  $(2f_l + f_s')$  after FM modulation is carried out with a baseband signal. The composing device 35 compounds the inputted radio FM signal and the 2nd higher harmonic signal of the local oscillation signal of frequency  $2f_l$  inputted from the band-pass filter 39, and outputs the composite signal concerned to the laser diode 37. The laser diode 37 has nonlinear electrical and electric equipment and light transfer characteristics, and the electrical and electric equipment and light conversion carry out the composite signal inputted using the above-mentioned transfer characteristic, The lightwave signal after the conversion concerned by which intensity modulation was carried out with the above-mentioned composite signal is outputted to fiber optic cable FC2, and the lightwave signal concerned is transmitted to the photodetector 20 in the main base station 101 by this via fiber optic cable FC2. Since the laser diode 37 has the electrical and electric equipment and light transfer characteristics nonlinear as mentioned above, here the lightwave signal concerned, Electrical signals, such as a radio FM signal of frequency  $(2f_l + f_s')$ , a local oscillation signal of frequency  $2f_l$ , an FM signal of frequency  $\{(2f_l + f_s') - 2f_l = f_s'\}$ , and a radio FM signal of frequency  $\{(2f_l + f_s') + 2f_l = 4f_l + f_s'\}$ , are included.

[0046]Detect the lightwave signal which the photodetector 20 was transmitted via fiber optic cable FC2, and was inputted in the main base station 101, and Light, after carrying out electrical conversion, The electrical signal after the conversion concerned is outputted to FM demodulator 22 via the band-pass filter 21 which mainly passes only the FM signal ingredient of frequency  $f_s'$ . FM demodulator 22 processes FM recovery to the inputted FM signal, and restores to it and outputs a baseband signal.

[0047]Here the radio FM signal of frequency  $(2f_l + f_s')$ , Down conversion can be carried out to the FM signal of lower frequency using the local oscillation signal of frequency  $2f_l$  compounded and inputted [ in / both / the laser diode 37 of \*\*\*\*\* 201 ], After carrying out zone wave filtration of the FM signal after frequency conversion with the band-pass filter 21 of the main base station 101, a baseband signal can be acquired by carrying out FM recovery. That is, the laser diode 37 is used not only as the electrical and electric equipment and a light-transforming element but as a mixer for high frequency.

[0048]Drawing 5 is a graph which shows the example of the characteristic of the power level of the electrical signal included in the lightwave signal over the power level of the electrical signal inputted outputted in the laser diode 13t of the main base station 101 of the 2nd example. Each preset value at the time of measurement of this characteristic is as follows.

Frequency  $f_s$  of the carrier signal inputted = frequency  $f_l = 4\text{GHz}$  of the local oscillation signal inputted 0.9 GHz, bias current  $I_d = 35\text{mA}$  of the laser diode 13t [0049]It turns out that it is contained in the lightwave signal outputted from the laser diode 13t, and the signal of frequency  $(2f_l + f_s)$ , the signal of frequency  $(2f_l - f_s)$ , and the signal of frequency  $2f_l$  are included after frequency conversion as an electrical signal outputted from the photodetector 30 so that clearly from drawing 5.

[0050]The lightwave transmission system for radio links of the 2nd example constituted as mentioned above, Since it is not necessary to form the local oscillation signal generator 36 in \*\*\*\*\* 201 as compared with the 1st example while having the same effect as the 1st example, the composition of \*\*\*\*\* becomes easy and the miniaturization and economization can be attained.

[0051]In the above example [ 2nd ], in the laser diode 13t in the main base station 101, while generating the 2nd higher harmonic signal of the local oscillation signal of frequency  $2f_l$  using nonlinear its electrical and electric equipment and light transfer characteristics, In [ mix the 2nd higher harmonic signal concerned and FM signal of the carrier frequency  $f_s$ , generate the radio

FM signal of frequency ( $2f + f_s$ ), transmit a lightwave signal including these electrical signals to \*\*\*\*\* 201, and ] \*\*\*\*\* 201, While carrying out zone wave filtration of the radio FM signal of frequency ( $2f + f_s$ ) and using it as a transmitting radio signal to the moving terminal office 300 with the band-pass filter 38, Zone wave filtration of the 2nd higher harmonic signal of the above-mentioned local oscillation signal is carried out with the band-pass filter 39, and the radio FM signal which received the 2nd harmonics of the above-mentioned local oscillation signal concerned which carried out zone wave filtration is used as a local oscillation signal for carrying out down conversion. However, this invention may use other higher harmonic signals, such as the 3rd, 4th, 5th, or 6th higher harmonic signal of a local oscillation signal, instead of the 2nd higher harmonic signal of not only this but a local oscillation signal.

[0052]In the above example [ 2nd ], although only one \*\*\*\*\* 201 and the one moving terminal office 300 are shown, not only this but \*\*\*\*\* 201 and two or more moving terminal offices 300 of plurality respectively may be provided.

[0053]<3rd example> drawing 3 is a block diagram of the lightwave transmission system for radio links which is the 3rd example concerning this invention.

[0054]The lightwave transmission system for radio links of this 3rd example, The main base station 102 and three \*\*\*\*\* 200a, 200b, and 200c which only a predetermined distance separated and were provided from the main base station 102, respectively, The six fiber optic cables FC11 thru/or FC13 for connecting the main base station 102 and each \*\*\*\*\* 200a, 200b, and 200c, FC21 to FC23, It comprises the moving terminal office 300a connected with \*\*\*\*\* 200a via a wireless circuit, the moving terminal office 300b connected with \*\*\*\*\* 200b via a wireless circuit, and the moving terminal office 300c connected with \*\*\*\*\* 200c via a wireless circuit.

[0055]In the main base station 102, each FM modulators 10a, 10b, and 10c, each local oscillation signal generators 11a, 11b, and 11c, and each composing devices 12a, 12b, and 12c operate like them of the 1st example. Each laser diodes 10a, 10b, and 10c answer the composite signal inputted, operate like them of the 1st example, generate each lightwave signal which has the mutually different 1st thru/or the 3rd wavelength, and output it to the photosynthesis machine 60, respectively. Subsequently, after the photosynthesis machine 60 carries out wavelength multiplexing composition of the three inputted lightwave signals, The multiplexed light signal after multiplex composition is transmitted to the optical branching circuit 71 established in \*\*\*\*\* 200a via the light amplifier 61 for compensating the multiplexing loss of the photosynthesis machine 60, and the loss of each fiber optic cable FC11, FC12, and FC13, and fiber optic cable FC11.

[0056]While the optical branching circuit 71 carries out selection wave filtration of the lightwave signal which has the 1st wavelength among the inputted multiplexed light signals and outputs it to \*\*\*\*\* 200a in \*\*\*\*\* 200a, It transmits to the optical branching circuit 72 in which each lightwave signal which has the 2nd and the 3rd wavelength is formed by \*\*\*\*\* 200b via fiber optic cable FC12.

[0057]\*\*\*\*\* 200a performs the processing same about the inputted lightwave signal as \*\*\*\*\* 200 of the 1st example. Here, a wireless circuit is set up like the 1st example between the transmitting antennas 40a of \*\*\*\*\* 200a, and the transmitting antennas 41a of the moving terminal office 300a. A lightwave signal including the information on the radio signal received by \*\*\*\*\* 200a is outputted to the photosynthesis machine 81. The photosynthesis machine 81 carries out wavelength multiplexing of the lightwave signal transmitted via fiber optic cable FC22 from the photosynthesis machine 82 of \*\*\*\*\* 200b so that it may mention later, and the lightwave signal outputted from \*\*\*\*\* 200a, and compounds it, The compounded multiplexed light signal is transmitted to the optical distributor 63 of the main base station 102 via the light amplifier 62 for compensating fiber optic cable FC21 and the spectral separation loss of the optical distributor 63, and the loss of each fiber optic cable FC21, FC22, and FC23.

[0058]In \*\*\*\*\* 200b, the optical branching circuit 72 transmits the lightwave signal which has the 3rd wavelength to \*\*\*\*\* 200c via fiber optic cable FC13 while it carries out selection wave filtration of the lightwave signal which has the 2nd wavelength among the inputted multiplexed light signals and outputs it to \*\*\*\*\* 200b.

[0059]\*\*\*\*\* 200b performs the processing same about the inputted lightwave signal as \*\*\*\*\* 200 of the 1st example. Here, a wireless circuit is set up like the 1st example between the transmitting antennas 40b of \*\*\*\*\* 200b, and the transmitting antennas 41b of the moving terminal office 300b. A lightwave signal including the information on the radio signal received by \*\*\*\*\* 200b is outputted to the photosynthesis machine 82. The photosynthesis machine 82 carries out wavelength multiplexing of the lightwave signal transmitted via fiber optic cable FC23 from \*\*\*\*\* 200c so that it may mention later, and the lightwave signal outputted from \*\*\*\*\* 200b, and compounds it, The compounded multiplexed light signal is transmitted to the photosynthesis machine 81 of \*\*\*\*\* 200a via fiber optic cable FC22.

[0060]\*\*\*\*\* 200c performs the processing same about the lightwave signal transmitted via fiber optic cable FC13 as \*\*\*\*\* 200 of the 1st example. Here, a wireless circuit is set up like the 1st example between the transmitting antennas 40c of \*\*\*\*\* 200c, and the transmitting antennas 41c of the moving terminal office 300c. A lightwave signal including the information on the radio signal received by \*\*\*\*\* 200c is transmitted to the photosynthesis machine 82 of \*\*\*\*\* 200b via fiber optic cable FC23.

[0061]In the main base station 100, the optical distributor 63 distributes each lightwave signal which has transmitted mutually different wavelength according to wavelength, and outputs it to each photodetectors 20a, 20b, and 20c. The lightwave signal outputted and transmitted from \*\*\*\*\* 200a is outputted to the photodetector 20a here, the lightwave signal outputted and transmitted from \*\*\*\*\* 200b is outputted to the photodetector 20b, and the lightwave signal outputted and transmitted from \*\*\*\*\* 200c is outputted to the photodetector 20c. Each photodetectors 20a, 20b, and 20c, each band-pass filters 21a, 21b, and 21c, and each FM demodulators 22a, 22b, and 22c operate like them of the 1st example.

[0062]In the 3rd example constituted as mentioned above, since the light amplifiers 61 and 62 are formed in order to compensate an above-mentioned loss, the area in which \*\*\*\*\* 200a, 200b, and 200c can be accommodated is substantially expandable.

[0063]In the above example [ 3rd ], when using 1 set of transmission and reception frequency in each \*\*\*\*\* 200a, 200b, and 200c, respectively, the baseband FM signal transmitted may be a signal with which Time Division Multiplexing of two or more baseband signals was carried out. When using two or more transmission and reception frequency of a group in each \*\*\*\*\* 200a, 200b, and 200c, respectively, the baseband FM signal transmitted may be a signal with which frequency multiplexing of two or more baseband signals was carried out.

[0064]In the above example [ 3rd ], the main base station 100 of the 1st example is applied to the main base station 102, and \*\*\*\*\* 200a, 200b, and 200c have the same composition as \*\*\*\*\* 200 of the 1st example. However, this invention may apply the main base station 100 of the 2nd example not only to this but to the main base station 102, and \*\*\*\*\* 200a, 200b, and 200c may be constituted so that it may have the same composition as \*\*\*\*\* 200 of the 2nd example.

[0065]In the 1st thru/or the 3rd example beyond <other examples>, although FM modulators 10, 10a, 10b, and 10c are used, this invention may use the modulator of other modulation methods, such as not only this but the FSK modulator.

[0066]In the above the 1st and 2nd example, wavelength multiplexing of each lightwave signal which transmits fiber optic cable FC1 and FC2, respectively may be carried out, and it may transmit using one fiber optic cable.

[0067]

[Effect of the Invention]According to the lightwave transmission system for radio links according to claim 1 applied to this invention as explained in full detail above. A main base station and \*\*\*\*\* which only a predetermined distance separated and was provided from the above-mentioned main base station, Are the optical transmission line which connects the above-mentioned main base station and the above-mentioned \*\*\*\*\* the lightwave transmission system for radio links which it had, and the above-mentioned main base station, The modulation means which modulates the carrier signal which has predetermined frequency with the information signal into which it is inputted, and outputs a modulating signal, It has a signal generation means which generates the local oscillation signal which has predetermined

frequency, and the nonlinear electrical and electric equipment and light transfer characteristics, The modulating signal outputted from the above-mentioned modulation means, and the local oscillation signal generated by the above-mentioned signal generation means, So that the above-mentioned modulating signal and the above-mentioned local oscillation signal may be mixed using the electrical and electric equipment and the light transfer characteristics of the above-mentioned non-linearity and the signal of at least one mixed frequency ingredient between the above-mentioned modulating signal and the above-mentioned local oscillation signal may arise. Have an electric light converting means which outputs the electrical and electric equipment and the lightwave signal which carries out light conversion and includes the signal of the above-mentioned mixed frequency ingredient to the above-mentioned optical transmission line, and the above-mentioned \*\*\*\*\*, The light and the electrical transducing means which outputs light and the electrical signal which carries out electrical conversion and includes the signal of the above-mentioned mixed frequency ingredient for the lightwave signal transmitted via the above-mentioned optical transmission line from the above-mentioned electric light converting means, the account of the upper by which wave filtration was carried out by the wave filtration means which carries out zone wave filtration of the signal of the mixed frequency ingredient beforehand decided among the electrical signals outputted from the above-mentioned light and electrical transducing means, and the above-mentioned wave filtration means — it has a transmitting means which carries out wireless transmission of the signal of the mixed frequency ingredient decided beforehand.

[0068]Therefore, since the above-mentioned main base station and the above-mentioned \*\*\*\*\* are connected using the above-mentioned optical transmission line, the radio wave interference to the wireless circuit set up between the above-mentioned \*\*\*\*\* and a terminal station from the radio-link system concerned can be lost. Since the radio frequency in the wireless circuit set up between the above-mentioned \*\*\*\*\* and the above-mentioned terminal station by setting up suitably the carrier frequency of the above-mentioned information signal and the frequency of the above-mentioned local oscillation signal by the above-mentioned main base station side can be set up arbitrarily, For example, the radio frequency in two or more microcell zones formed of two or more \*\*\*\*\*, respectively can be set up easily.

[0069]In the above-mentioned \*\*\*\*\*, since it does not have the signal processor of the above-mentioned information signal, the composition of the above-mentioned \*\*\*\*\* can be miniaturized and economized, and the \*\*\*\*\* concerned can be installed in a smaller space. Therefore, it becomes possible to install many walkie-talkies for each radio channel in each microcell zone by the predetermined installing space of the above-mentioned \*\*\*\*\*.

[0070]The stability of the frequency of the sending signal transmitted from the above-mentioned \*\*\*\*\*, Since it is determined by the stability of the frequency of the carrier signal of the modulating signal inputted into the above-mentioned electric light converting means, and the stability of the frequency of the above-mentioned local oscillation signal, By raising the stability of the carrier frequency of the carrier wave signal generator in the above-mentioned main base station, and the stability of the oscillating frequency of a local oscillation signal generator, the stability of the frequency of the sending signal in a wireless circuit can be raised easily.

[0071]Again. According to the lightwave transmission system for radio links according to claim 6 concerning this invention. A main base station and \*\*\*\*\* which only a predetermined distance separated and was provided from the above-mentioned main base station, Are the 1st which connects the above-mentioned main base station and the above-mentioned \*\*\*\*\*, and the 2nd optical transmission line the lightwave transmission system for radio links which it had, and the above-mentioned main base station, The modulation means which modulates the carrier signal which has predetermined frequency with the 1st information signal into which it is inputted, and outputs a modulating signal, It has a signal generation means which generates the local oscillation signal which has predetermined frequency, and the nonlinear electrical and electric equipment and light transfer characteristics, While answering the local oscillation signal generated by the above-mentioned signal generation means and generating at least one higher harmonic signal of the above-mentioned local oscillation signal using the electrical and electric equipment and the light transfer characteristics of the above-mentioned non-linearity, The



higher harmonic signal generated [ above-mentioned ] with the modulating signal outputted from the above-mentioned modulation means, So that the signal of at least one mixed frequency ingredient between the higher harmonic signals which mixed the higher harmonic signal generated [ above-mentioned ] with the above-mentioned modulating signal using the electrical and electric equipment and the light transfer characteristics of the above-mentioned non-linearity, and were generated [ above-mentioned ] with the above-mentioned modulating signal may arise. It has the 1st electric light converting means that outputs the higher harmonic signal generated [ above-mentioned ] by carrying out the electrical and electric equipment and light conversion, and the 1st lightwave signal including the signal of the above-mentioned mixed frequency ingredient to the 1st optical transmission line of the above, The 1st light and electrical transducing means that outputs the higher harmonic signal generated [ above-mentioned ] by the above-mentioned \*\*\*\*\* carrying out light and electrical conversion of the 1st lightwave signal transmitted via the 1st optical transmission line of the above from the 1st electric light converting means of the above, and an electrical signal including the signal of the above-mentioned mixed frequency ingredient, The 1st wave filtration means that carries out zone wave filtration of the signal of one mixed frequency ingredient beforehand decided among the electrical signals outputted from the light and the electrical transducing means of the above 1st, The 2nd wave filtration means that carries out zone wave filtration of the one higher harmonic signal beforehand decided among the electrical signals outputted from the light and the electrical transducing means of the above 1st, The transmitting means which carries out wireless transmission of the signal of the above-mentioned mixed frequency ingredient by which wave filtration was carried out by the wave filtration means of the above 1st, The reception means which carries out radio receiving of the sending signal which has the predetermined radio frequency by which wireless transmission was modulated and carried out with the 2nd information signal in the distant office, and outputs an input signal, The above-mentioned higher harmonic signal by which wave filtration was carried out by the input signal and the wave filtration means of the above 2nd which have nonlinear electrical and electric equipment and light transfer characteristics, and are outputted from the above-mentioned reception means, So that the signal of at least one mixed frequency ingredient between the higher harmonic signals by which mixed the higher harmonic signal by which wave filtration was carried out [ above-mentioned ] to the above-mentioned input signal using the electrical and electric equipment and the light transfer characteristics of the above-mentioned non-linearity, and wave filtration was carried out [ above-mentioned ] to the above-mentioned input signal may arise. It has the 2nd electric light converting means that outputs the electrical and electric equipment and the 2nd lightwave signal that carries out light conversion and includes the signal of the above-mentioned mixed frequency ingredient to the 2nd optical transmission line of the above, The 2nd light and electrical transducing means to which the above-mentioned main base station outputs further light and the electrical signal which carries out electrical conversion and includes the signal of the above-mentioned mixed frequency ingredient for the 2nd lightwave signal transmitted via the 2nd optical transmission line of the above from the 2nd electric light converting means of the above, The 3rd wave filtration means that carries out zone wave filtration of the signal of the 2nd mixed frequency ingredient beforehand decided among the electrical signals outputted from the light and the electrical transducing means of the above 2nd, It has a demodulation means which restores to the signal of the mixed frequency ingredient of the above 2nd by which wave filtration was carried out, and outputs the 2nd information signal of the above by the wave filtration means of the above 3rd.

[0072]Therefore, the lightwave transmission system for radio links concerned according to claim 6 has an above-mentioned effect. Since the above-mentioned higher harmonic signal acquired from the above-mentioned main base station by carrying out light and electrical conversion of the transmitted lightwave signal for the frequency conversion of the received radio signal is used as a local oscillation signal, The composition of the above-mentioned \*\*\*\*\* can be simplified as compared with the case where the generator made to generate a local oscillation signal in the above-mentioned \*\*\*\*\* is formed, and a miniaturization and economization of the above-mentioned \*\*\*\*\* can be attained by this. Since the harmonic content of the local oscillation



signal generated in the above-mentioned main base station is used as a local oscillation signal in the above 1st and the 2nd electric light converting means, the flexibility of setting out of the transmission and reception frequency of the wireless circuit between the above-mentioned \*\*\*\*\* and the above-mentioned terminal station can be increased as compared with a conventional example.

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[Translation done.]

\* NOTICES \*

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- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.\*\*\*\* shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1]It is a block diagram of the lightwave transmission system for radio links which is the 1st example concerning this invention.

[Drawing 2]It is a block diagram of the lightwave transmission system for radio links which is the 2nd example concerning this invention.

[Drawing 3]It is a block diagram of the lightwave transmission system for radio links which is the 3rd example concerning this invention.

[Drawing 4]It is a graph which shows the example of the characteristic of the power level of the electrical signal included in the lightwave signal over the power level of the electrical signal inputted outputted in the laser diode of the main base station in the 1st example.

[Drawing 5]It is a graph which shows the example of the characteristic of the power level of the electrical signal included in the lightwave signal over the power level of the electrical signal inputted outputted in the laser diode of the main base station in the 2nd example.

[Description of Notations]

- 10 — FM modulator
- 11, 36 — Local oscillation signal generator,
- 12, 35 — Composing device,
- 13, 13t, 37 — Laser diode,
- 20, 30 — Photodetector,
- 22 — FM demodulator
- 21, 31, 38, 39 — Band-pass filter
- 32 — Transmit power amplifier,
- 34 — Head amplifier,
- 40, 41 — Transmitting antennas
- 100,101 — Main base station,
- 200,201 — \*\*\*\*\*,
- 300 — Moving terminal office,
- FC1, FC2 — Fiber optic cable.

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[Translation done.]

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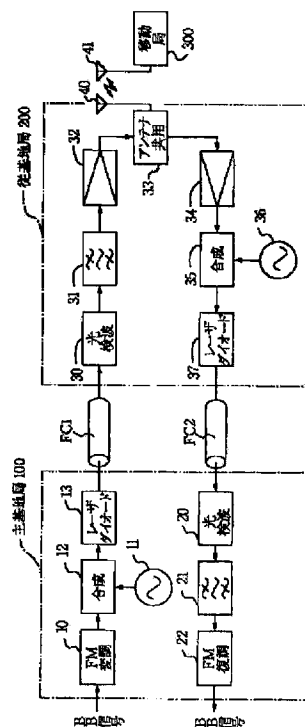
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(54)【発明の名称】 無線リンク用光伝送システム

(57)【要約】

【目的】 従来例に比較し構成が簡単であって、しかも無線回線を用いず主基地局と従基地局とを接続し無線リンク用信号を伝送することができる無線リンク用光伝送システムを提供する。

【構成】 主基地局において、搬送波信号を情報信号で変調して変調信号を出力し、一方、局部発振信号を発生する。次いで、変調信号と局部発振信号とを、非線形の電気・光変換特性を用いて変調信号と局部発振信号とを混合しこれらの各信号間の少なくとも1つの混合周波数成分の信号が生じるように電気・光変換して混合周波数成分の信号を含む光信号を光伝送線路に出力する。一方、従基地局において、光伝送線路を介して伝送された光信号を光・電気変換して混合周波数成分の信号を含む電気信号を出力し、出力される電気信号のうち予め決められた混合周波数成分の信号を帯域ろ波し、ろ波された混合周波数成分の信号を無線送信する。



## 【特許請求の範囲】

【請求項1】 主基地局と、上記主基地局から所定の距離だけ離れて設けられた従基地局と、上記主基地局と上記従基地局とを接続する光伝送線路とを備えた無線リンク用光伝送システムであって、

上記主基地局は、

所定の周波数を有する搬送波信号を、入力される情報信号で変調して変調信号を出力する変調手段と、

所定の周波数を有する局部発振信号を発生する信号発生手段と、

非線形の電気・光変換特性を有し、上記変調手段から出力される変調信号と上記信号発生手段によって発生された局部発振信号とを、上記非線形の電気・光変換特性を用いて上記変調信号と上記局部発振信号とを混合し上記変調信号と上記局部発振信号との間の少なくとも1つの混合周波数成分の信号が生じるように電気・光変換して上記混合周波数成分の信号を含む光信号を上記光伝送線路に出力する電気・光変換手段とを備え、

上記従基地局は、

上記電気・光変換手段から上記光伝送線路を介して伝送された光信号を光・電気変換して上記混合周波数成分の信号を含む電気信号を出力する光・電気変換手段と、

上記光・電気変換手段から出力される電気信号のうち予め決められた混合周波数成分の信号を帯域ろ波するろ波手段と、

上記ろ波手段によってろ波された上記予め決められた混合周波数成分の信号を無線送信する送信手段とを備えたことを特徴とする無線リンク用光伝送システム。

【請求項2】 主基地局と、上記主基地局から所定の距離だけ離れて設けられた従基地局と、上記主基地局と上記従基地局とを接続する光伝送線路とを備えた無線リンク用光伝送システムであって、

上記従基地局は、

相手局において情報信号で変調されて無線送信された所定の無線周波数を有する送信信号を無線受信して受信信号を出力する受信手段と、

所定の周波数を有する局部発振信号を発生する信号発生手段と、

非線形の電気・光変換特性を有し、上記受信手段から出力される受信信号と上記信号発生手段によって発生された局部発振信号とを、上記非線形の電気・光変換特性を用いて上記受信信号と上記局部発振信号とを混合し上記受信信号と上記局部発振信号との間の少なくとも1つの混合周波数成分の信号が生じるように電気・光変換して上記混合周波数成分の信号を含む光信号を上記光伝送線路に出力する電気・光変換手段とを備え、

上記主基地局は、

上記電気・光変換手段から上記光伝送線路を介して伝送された光信号を光・電気変換して上記混合周波数成分の信号を含む電気信号を出力する光・電気変換手段と、

上記光・電気変換手段から出力される電気信号のうち予め決められた混合周波数成分の信号を帯域ろ波するろ波手段と、

上記ろ波手段によってろ波された上記混合周波数成分の信号を復調して上記情報信号を出力する復調手段とを備えたことを特徴とする無線リンク用光伝送システム。

【請求項3】 主基地局と、上記主基地局から所定の距離だけ離れて設けられた従基地局と、上記主基地局と上記従基地局とを接続する第1と第2の光伝送線路とを備えた無線リンク用光伝送システムであって、

上記主基地局は、

所定の周波数を有する搬送波信号を、入力される第1の情報信号で変調して変調信号を出力する変調手段と、

所定の周波数を有する第1の局部発振信号を発生する第1の信号発生手段と、

非線形の電気・光変換特性を有し、上記変調手段から出力される変調信号と上記第1の信号発生手段によって発生された第1の局部発振信号とを、上記非線形の電気・光変換特性を用いて上記変調信号と上記第1の局部発振信号とを混合し上記変調信号と上記第1の局部発振信号との間の少なくとも1つの混合周波数成分の信号が生じるように電気・光変換して上記混合周波数成分の信号を含む第1の光信号を上記第1の光伝送線路に出力する第1の電気・光変換手段とを備え、

上記従基地局は、

上記第1の電気・光変換手段から上記第1の光伝送線路を介して伝送された第1の光信号を光・電気変換して上記混合周波数成分の信号を含む電気信号を出力する第1の光・電気変換手段と、

上記第1の光・電気変換手段から出力される電気信号のうち予め決められた第1の混合周波数成分の信号を帯域ろ波する第1のろ波手段と、

上記第1のろ波手段によってろ波された上記第1の混合周波数成分の信号を無線送信する送信手段と、

相手局において第2の情報信号で変調されて無線送信された所定の無線周波数を有する送信信号を無線受信して受信信号を出力する受信手段と、

所定の周波数を有する第2の局部発振信号を発生する第2の信号発生手段と、

非線形の電気・光変換特性を有し、上記受信手段から出力される受信信号と上記第2の信号発生手段によって発生された第2の局部発振信号とを、上記非線形の電気・光変換特性を用いて上記受信信号と上記第2の局部発振信号とを混合し上記受信信号と上記第2の局部発振信号との間の少なくとも1つの混合周波数成分の信号が生じるように電気・光変換して上記混合周波数成分の信号を含む第2の光信号を上記第2の光伝送線路に出力する第2の電気・光変換手段とを備え、

上記主基地局はさらに、

上記第2の電気・光変換手段から上記第2の光伝送線路

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を介して伝送された第2の光信号を光・電気変換して上記混合周波数成分の信号を含む電気信号を出力する第2の光・電気変換手段と、  
 上記第2の光・電気変換手段から出力される電気信号のうち予め決められた第2の混合周波数成分の信号を帯域ろ波する第2のろ波手段と、  
 上記第2のろ波手段によってろ波された上記第2の混合周波数成分の信号を復調して上記第2の情報信号を出力する復調手段とを備えたことを特徴とする無線リンク用光伝送システム。

【請求項4】 上記第1と第2の光信号は波長多重されて1本の光伝送線を介して伝送されることを特徴とする請求項3記載の無線リンク用光伝送システム。

【請求項5】 主基地局と、上記主基地局から所定の距離だけ離れて設けられた従基地局と、上記主基地局と上記従基地局とを接続する光伝送線路とを備えた無線リンク用光伝送システムであって、

上記主基地局は、

所定の周波数を有する搬送波信号を、入力される情報信号で変調して変調信号を出力する変調手段と、

所定の周波数を有する局部発振信号を発生する信号発生手段と、

非線形の電気・光変換特性を有し、上記信号発生手段によって発生された局部発振信号にตอบสนองして上記非線形の電気・光変換特性を用いて上記局部発振信号の少なくとも1つの高調波信号を発生するとともに、上記変調手段から出力される変調信号と上記発生された高調波信号とを、上記非線形の電気・光変換特性を用いて上記変調信号と上記発生された高調波信号とを混合し上記変調信号と上記発生された高調波信号との間の少なくとも1つの混合周波数成分の信号が生じるように電気・光変換して上記混合周波数成分の信号を含む光信号を上記光伝送線路に出力する電気・光変換手段とを備え、

上記従基地局は、

上記電気・光変換手段から上記光伝送線路を介して伝送された光信号を光・電気変換して上記混合周波数成分の信号を含む電気信号を出力する光・電気変換手段と、

上記光・電気変換手段から出力される電気信号のうち予め決められた1つの混合周波数成分の信号を帯域ろ波するろ波手段と、

上記ろ波手段によってろ波された上記混合周波数成分の信号を無線送信する送信手段とを備えたことを特徴とする無線リンク用光伝送システム。

【請求項6】 主基地局と、上記主基地局から所定の距離だけ離れて設けられた従基地局と、上記主基地局と上記従基地局とを接続する第1と第2の光伝送線路とを備えた無線リンク用光伝送システムであって、

上記主基地局は、

所定の周波数を有する搬送波信号を、入力される第1の情報信号で変調して変調信号を出力する変調手段と、

所定の周波数を有する局部発振信号を発生する信号発生手段と、

非線形の電気・光変換特性を有し、上記信号発生手段によって発生された局部発振信号にตอบสนองして上記非線形の電気・光変換特性を用いて上記局部発振信号の少なくとも1つの高調波信号を発生するとともに、上記変調手段から出力される変調信号と上記発生された高調波信号とを、上記非線形の電気・光変換特性を用いて上記変調信号と上記発生された高調波信号とを混合し上記変調信号と上記発生された高調波信号との間の少なくとも1つの混合周波数成分の信号が生じるように電気・光変換して上記発生された高調波信号と上記混合周波数成分の信号を含む第1の光信号を上記第1の光伝送線路に出力する第1の電気・光変換手段とを備え、

上記従基地局は、

上記第1の電気・光変換手段から上記第1の光伝送線路を介して伝送された第1の光信号を光・電気変換して上記発生された高調波信号と上記混合周波数成分の信号を含む電気信号を出力する第1の光・電気変換手段と、

上記第1の光・電気変換手段から出力される電気信号のうち予め決められた1つの混合周波数成分の信号を帯域ろ波する第1のろ波手段と、

上記第1の光・電気変換手段から出力される電気信号のうち予め決められた1つの高調波信号を帯域ろ波する第2のろ波手段と、

上記第1のろ波手段によってろ波された上記混合周波数成分の信号を無線送信する送信手段と、

相手局において第2の情報信号で変調されて無線送信された所定の無線周波数を有する送信信号を無線受信して受信信号を出力する受信手段と、

非線形の電気・光変換特性を有し、上記受信手段から出力される受信信号と上記第2のろ波手段によってろ波された上記高調波信号とを、上記非線形の電気・光変換特性を用いて上記受信信号と上記ろ波された高調波信号とを混合し上記受信信号と上記ろ波された高調波信号との間の少なくとも1つの混合周波数成分の信号が生じるように電気・光変換して上記混合周波数成分の信号を含む第2の光信号を上記第2の光伝送線路に出力する第2の電気・光変換手段とを備え、

上記主基地局はさらに、

上記第2の電気・光変換手段から上記第2の光伝送線路を介して伝送された第2の光信号を光・電気変換して上記混合周波数成分の信号を含む電気信号を出力する第2の光・電気変換手段と、

上記第2の光・電気変換手段から出力される電気信号のうち予め決められた第2の混合周波数成分の信号を帯域ろ波する第3のろ波手段と、

上記第3のろ波手段によってろ波された上記第2の混合周波数成分の信号を復調して上記第2の情報信号を出力する復調手段とを備えたことを特徴とする無線リンク用

光伝送システム。

【請求項7】 上記第1と第2の光信号は波長多重されて1本の光伝送線路を介して伝送されることを特徴とする請求項6記載の無線リンク用光伝送システム。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、ベースバンド信号の変復調を行なう主基地局と、端末局と無線回線を介して送受信するための送受信装置を備えた従基地局とが離れているときに、上記無線回線を介して送受信するための信号（以下、無線リンク用信号という。）を光ファイバケーブルを用いて伝送するための無線リンク用光伝送システムに関し、特に、自動車電話システム、パーソナル通信システムなどの移動体通信システムに適用可能な無線リンク用光伝送システムに関する。

【0002】

【従来の技術】従来の移動通信システムにおいて、基地局でベースバンド信号の信号処理を行うために基地局の装置構成が複雑かつ大型になり、多数の基地局を必要とするゾーン半径が小さなマイクロセルゾーン又はピコセルゾーンの各々に基地局を設置することが困難になってきている。この問題点を解決するため、マイクロセルゾーン又はピコセルゾーンをカバーする従基地局に、ベースバンド信号の信号処理装置を設けず、無線通信に関するアナログ信号処理のみの送受信装置のみを設けて基地局の簡易化を図ることが提案されている。

【0003】具体的には、例えば、主基地局においてベースバンド信号を多重化して得られた多重信号で搬送波を変調した後、当該変調信号を無線回線又は同軸ケーブルを用いた有線回線を介して従基地局に伝送する。そして、従基地局では、受信された変調信号を無線信号に周波数変換し、当該無線信号を移動端末局に向けて送信して無線通信を行なう。

【0004】

【発明が解決しようとする課題】しかしながら、この従来のシステムにおいて、主基地局と従基地局とを無線回線を介して接続した場合、主基地局と複数の従基地局との間で多数の無線回線を設定する必要があるため、電波の有効利用を図ることが難しくなるとともに、主基地局と従基地局とを接続する無線回線どうし、並びに当該無線回線と従基地局と移動端末局とを接続する無線回線との電波干渉の問題を回避する必要があるという問題点があった。

【0005】また、上記の従来のシステムにおいて、主基地局と従基地局とを同軸ケーブルを用いた有線回線を介して接続した場合、当該同軸ケーブルの線路損失のために搬送波周波数に上限が存在すること、並びに、主基地局と従基地局との間の距離に制限があるという問題点があった。

【0006】本発明の目的は以上の問題点を解決し、従

来例に比較し構成が簡単であって、しかも無線回線を用いず主基地局と従基地局とを接続し無線リンク用信号を伝送することができる無線リンク用光伝送システムを提供することにある。

【0007】

【課題を解決するための手段】本発明に係る請求項1記載の無線リンク用光伝送システムは、主基地局と、上記主基地局から所定の距離だけ離れて設けられた従基地局と、上記主基地局と上記従基地局とを接続する光伝送線路とを備えた無線リンク用光伝送システムであって、上記主基地局は、所定の周波数を有する搬送波信号を、入力される情報信号で変調して変調信号を出力する変調手段と、所定の周波数を有する局部発振信号を発生する信号発生手段と、非線形の電気・光変換特性を有し、上記変調手段から出力される変調信号と上記信号発生手段によって発生された局部発振信号とを、上記非線形の電気・光変換特性を用いて上記変調信号と上記局部発振信号とを混合し上記変調信号と上記局部発振信号との間の少なくとも1つの混合周波数成分の信号が生じるように電気・光変換して上記混合周波数成分の信号を含む光信号を上記光伝送線路に出力する電気・光変換手段とを備え、上記従基地局は、上記電気・光変換手段から上記光伝送線路を介して伝送された光信号を光・電気変換して上記混合周波数成分の信号を含む電気信号を出力する光・電気変換手段と、上記光・電気変換手段から出力される電気信号のうち予め決められた混合周波数成分の信号を帯域ろ波するろ波手段と、上記ろ波手段によってろ波された上記予め決められた混合周波数成分の信号を無線送信する送信手段とを備えたことを特徴とする。

【0008】また、本発明に係る請求項2記載の無線リンク用光伝送システムは、主基地局と、上記主基地局から所定の距離だけ離れて設けられた従基地局と、上記主基地局と上記従基地局とを接続する光伝送線路とを備えた無線リンク用光伝送システムであって、上記従基地局は、相手局において情報信号で変調されて無線送信された所定の無線周波数を有する送信信号を無線受信して受信信号を出力する受信手段と、所定の周波数を有する局部発振信号を発生する信号発生手段と、非線形の電気・光変換特性を有し、上記受信手段から出力される受信信号と上記信号発生手段によって発生された局部発振信号とを、上記非線形の電気・光変換特性を用いて上記受信信号と上記局部発振信号とを混合し上記受信信号と上記局部発振信号との間の少なくとも1つの混合周波数成分の信号が生じるように電気・光変換して上記混合周波数成分の信号を含む光信号を上記光伝送線路に出力する電気・光変換手段とを備え、上記主基地局は、上記電気・光変換手段から上記光伝送線路を介して伝送された光信号を光・電気変換して上記混合周波数成分の信号を含む電気信号を出力する光・電気変換手段と、上記光・電気変換手段から出力される電気信号のうち予め決められた

混合周波数成分の信号を帯域ろ波するろ波手段と、上記ろ波手段によってろ波された上記混合周波数成分の信号を復調して上記情報信号を出力する復調手段とを備えたことを特徴とする。

【0009】さらに、本発明に係る請求項3記載の無線リンク用光伝送システムは、主基地局と、上記主基地局から所定の距離だけ離れて設けられた従基地局と、上記主基地局と上記従基地局とを接続する第1と第2の光伝送線路とを備えた無線リンク用光伝送システムであつて、上記主基地局は、所定の周波数を有する搬送波信号を、入力される第1の情報信号で変調して変調信号を出力する変調手段と、所定の周波数を有する第1の局部発振信号を発生する第1の信号発生手段と、非線形の電気・光変換特性を有し、上記変調手段から出力される変調信号と上記第1の信号発生手段によって発生された第1の局部発振信号とを、上記非線形の電気・光変換特性を用いて上記変調信号と上記第1の局部発振信号とを混合し上記変調信号と上記第1の局部発振信号との間の少なくとも1つの混合周波数成分の信号が生じるように電気・光変換して上記混合周波数成分の信号を含む第1の光信号を上記第1の光伝送線路に出力する第1の電気・光変換手段とを備え、上記従基地局は、上記第1の電気・光変換手段から上記第1の光伝送線路を介して伝送された第1の光信号を光・電気変換して上記混合周波数成分の信号を含む電気信号を出力する第1の光・電気変換手段と、上記第1の光・電気変換手段から出力される電気信号のうち予め決められた第1の混合周波数成分の信号を帯域ろ波する第1のろ波手段と、上記第1のろ波手段によってろ波された上記第1の混合周波数成分の信号を無線送信する送信手段と、相手局において第2の情報信号で変調されて無線送信された所定の無線周波数を有する送信信号を無線受信して受信信号を出力する受信手段と、所定の周波数を有する第2の局部発振信号を発生する第2の信号発生手段と、非線形の電気・光変換特性を有し、上記受信手段から出力される受信信号と上記第2の信号発生手段によって発生された第2の局部発振信号とを、上記非線形の電気・光変換特性を用いて上記受信信号と上記第2の局部発振信号とを混合し上記受信信号と上記第2の局部発振信号との間の少なくとも1つの混合周波数成分の信号が生じるように電気・光変換して上記混合周波数成分の信号を含む第2の光信号を上記第2の光伝送線路に出力する第2の電気・光変換手段とを備え、上記主基地局はさらに、上記第2の電気・光変換手段から上記第2の光伝送線路を介して伝送された第2の光信号を光・電気変換して上記混合周波数成分の信号を含む電気信号を出力する第2の光・電気変換手段と、上記第2の光・電気変換手段から出力される電気信号のうち予め決められた第2の混合周波数成分の信号を帯域ろ波する第2のろ波手段と、上記第2のろ波手段によってろ波された上記第2の混合周波数成分の信号を復調して

上記第2の情報信号を出力する復調手段とを備えたことを特徴とする。

【0010】またさらに、請求項4記載の無線リンク用光伝送システムは、請求項3記載の無線リンク用光伝送システムにおいて、上記第1と第2の光信号は波長多重されて1本の光伝送線路を介して伝送されることを特徴とする。

【0011】本発明に係る請求項5記載の無線リンク用光伝送システムは、主基地局と、上記主基地局から所定の距離だけ離れて設けられた従基地局と、上記主基地局と上記従基地局とを接続する光伝送線路とを備えた無線リンク用光伝送システムであつて、上記主基地局は、所定の周波数を有する搬送波信号を、入力される情報信号で変調して変調信号を出力する変調手段と、所定の周波数を有する局部発振信号を発生する信号発生手段と、非線形の電気・光変換特性を有し、上記信号発生手段によって発生された局部発振信号にตอบสนองして上記非線形の電気・光変換特性を用いて上記局部発振信号の少なくとも1つの高調波信号を発生するとともに、上記変調手段から出力される変調信号と上記発生された高調波信号とを、上記非線形の電気・光変換特性を用いて上記変調信号と上記発生された高調波信号とを混合し上記変調信号と上記発生された高調波信号との間の少なくとも1つの混合周波数成分の信号が生じるように電気・光変換して上記混合周波数成分の信号を含む光信号を上記光伝送線路に出力する電気・光変換手段とを備え、上記従基地局は、上記電気・光変換手段から上記光伝送線路を介して伝送された光信号を光・電気変換して上記混合周波数成分の信号を含む電気信号を出力する光・電気変換手段と、上記光・電気変換手段から出力される電気信号のうち予め決められた1つの混合周波数成分の信号を帯域ろ波するろ波手段と、上記ろ波手段によってろ波された上記混合周波数成分の信号を無線送信する送信手段とを備えたことを特徴とする。

【0012】また、本発明に係る請求項6記載の無線リンク用光伝送システムは、主基地局と、上記主基地局から所定の距離だけ離れて設けられた従基地局と、上記主基地局と上記従基地局とを接続する第1と第2の光伝送線路とを備えた無線リンク用光伝送システムであつて、上記主基地局は、所定の周波数を有する搬送波信号を、入力される第1の情報信号で変調して変調信号を出力する変調手段と、所定の周波数を有する局部発振信号を発生する信号発生手段と、非線形の電気・光変換特性を有し、上記信号発生手段によって発生された局部発振信号にตอบสนองして上記非線形の電気・光変換特性を用いて上記局部発振信号の少なくとも1つの高調波信号を発生するとともに、上記変調手段から出力される変調信号と上記発生された高調波信号とを、上記非線形の電気・光変換特性を用いて上記変調信号と上記発生された高調波信号とを混合し上記変調信号と上記発生された高調波信号と

の間の少なくとも1つの混合周波数成分の信号が生じるように電気・光変換して上記発生された高調波信号と上記混合周波数成分の信号を含む第1の光信号を上記第1の光伝送線路に出力する第1の電気・光変換手段とを備え、上記従基地局は、上記第1の電気・光変換手段から上記第1の光伝送線路を介して伝送された第1の光信号を光・電気変換して上記発生された高調波信号と上記混合周波数成分の信号を含む電気信号を出力する第1の光・電気変換手段と、上記第1の光・電気変換手段から出力される電気信号のうち予め決められた1つの混合周波数成分の信号を帯域ろ波する第1のろ波手段と、上記第1の光・電気変換手段から出力される電気信号のうち予め決められた1つの高調波信号を帯域ろ波する第2のろ波手段と、上記第1のろ波手段によってろ波された上記混合周波数成分の信号を無線送信する送信手段と、相手局において第2の情報信号で変調されて無線送信された所定の無線周波数を有する送信信号を無線受信して受信信号を出力する受信手段と、非線形の電気・光変換特性を有し、上記受信手段から出力される受信信号と上記第2のろ波手段によってろ波された上記高調波信号とを、上記非線形の電気・光変換特性を用いて上記受信信号と上記ろ波された高調波信号とを混合し上記受信信号と上記ろ波された高調波信号との間の少なくとも1つの混合周波数成分の信号が生じるように電気・光変換して上記混合周波数成分の信号を含む第2の光信号を上記第2の光伝送線路に出力する第2の電気・光変換手段とを備え、上記主基地局はさらに、上記第2の電気・光変換手段から上記第2の光伝送線路を介して伝送された第2の光信号を光・電気変換して上記混合周波数成分の信号を含む電気信号を出力する第2の光・電気変換手段と、上記第2の光・電気変換手段から出力される電気信号のうち予め決められた第2の混合周波数成分の信号を帯域ろ波する第3のろ波手段と、上記第3のろ波手段によってろ波された上記第2の混合周波数成分の信号を復調して上記第2の情報信号を出力する復調手段とを備えたことを特徴とする。

【0013】さらに、請求項7記載の無線リンク用光伝送システムは、請求項6記載の無線リンク用光伝送システムにおいて、上記第1と第2の光信号は波長多重されて1本の光伝送線路を介して伝送されることを特徴とする。

【0014】

【作用】上記請求項1記載の無線リンク用光伝送システムにおいては、上記主基地局において、上記変調手段は、所定の周波数を有する搬送波信号を、入力される情報信号で変調して変調信号を出力し、一方、上記信号発生手段は、所定の周波数を有する局部発振信号を発生する。次いで、上記電気・光変換手段は、非線形の電気・光変換特性を有し、上記変調手段から出力される変調信号と上記信号発生手段によって発生された局部発振信号

とを、上記非線形の電気・光変換特性を用いて上記変調信号と上記局部発振信号とを混合し上記変調信号と上記局部発振信号との間の少なくとも1つの混合周波数成分の信号が生じるように電気・光変換して上記混合周波数成分の信号を含む光信号を上記光伝送線路に出力する。一方、上記従基地局において、上記光・電気変換手段は、上記電気・光変換手段から上記光伝送線路を介して伝送された光信号を光・電気変換して上記混合周波数成分の信号を含む電気信号を出力した後、上記ろ波手段は、上記光・電気変換手段から出力される電気信号のうち予め決められた混合周波数成分の信号を帯域ろ波する。次いで、上記送信手段は、上記ろ波手段によってろ波された上記予め決められた混合周波数成分の信号を無線送信する。

【0015】以上のように構成された請求項1記載の無線リンク用光伝送システムにおいては、上記主基地局と上記従基地局とを上記光伝送線路を用いて接続しているので、当該無線リンク系から上記従基地局と端末局との間で設定される無線回線への電波干渉を無くすることができる。上記主基地局側で上記情報信号の搬送周波数と上記局部発振信号の周波数とを適当に設定することにより、上記従基地局と上記端末局との間で設定される無線回線における無線周波数を任意に設定することができるので、例えば複数の従基地局によってそれぞれ形成される複数のマイクロセルゾーンにおける無線周波数の設定を容易に行なうことができる。以下、これを第1の作用効果という。また、上記従基地局においては、上記情報信号の信号処理装置を備えていないので、上記従基地局の構成を小型化かつ経済化することができ、より小さなスペースで当該従基地局を設置することができる。従って、上記従基地局の所定の設置スペースで各マイクロセルゾーンにおける各無線チャンネルのための無線機を多数設置することが可能となる。以下、これを第2の作用効果という。さらに、上記従基地局から送信される送信信号の周波数の安定度は、上記電気・光変換手段に入力される変調信号の搬送波信号の周波数の安定度と、上記局部発振信号の周波数の安定度によって決定されるので、上記主基地局内の搬送波信号発生器の搬送周波数の安定度と局部発振信号発生器の発振周波数の安定度を高めることにより、容易に無線回線における送信信号の周波数の安定度を高めることができる。以下、これを第3の作用効果という。

【0016】また、上記請求項2記載の無線リンク用光伝送システムにおいては、上記従基地局において、上記受信手段は、相手局において情報信号で変調されて無線送信された所定の無線周波数を有する送信信号を無線受信して受信信号を出力し、一方、上記信号発生手段は、所定の周波数を有する局部発振信号を発生する。次いで、上記電気・光変換手段は、非線形の電気・光変換特性を有し、上記受信手段から出力される受信信号と上記



信号発生手段によって発生された局部発振信号とを、上記非線形の電気・光変換特性を用いて上記受信信号と上記局部発振信号とを混合し上記受信信号と上記局部発振信号との間の少なくとも1つの混合周波数成分の信号が生じるように電気・光変換して上記混合周波数成分の信号を含む光信号を上記光伝送線路に出力する。一方、上記主基地局においては、上記光・電気変換手段は、上記電気・光変換手段から上記光伝送線路を介して伝送された光信号を光・電気変換して上記混合周波数成分の信号を含む電気信号を出力した後、上記ろ波手段は、上記光・電気変換手段から出力される電気信号のうち予め決められた混合周波数成分の信号を帯域ろ波する。次いで、上記復調手段は、上記ろ波手段によってろ波された上記混合周波数成分の信号を復調して上記情報信号を出力する。以上のように構成された請求項2記載の無線リンク用光伝送システムは、上記第1と第2の作用効果を有する。

【0017】さらに、上記請求項3記載の無線リンク用光伝送システムにおいては、上記主基地局においては、上記変調手段は、所定の周波数を有する搬送波信号を、入力される第1の情報信号で変調して変調信号を出力し、一方、上記第1の信号発生手段は、所定の周波数を有する第1の局部発振信号を発生する。次いで、上記第1の電気・光変換手段は、非線形の電気・光変換特性を有し、上記変調手段から出力される変調信号と上記第1の信号発生手段によって発生された第1の局部発振信号とを、上記非線形の電気・光変換特性を用いて上記変調信号と上記第1の局部発振信号とを混合し上記変調信号と上記第1の局部発振信号との間の少なくとも1つの混合周波数成分の信号が生じるように電気・光変換して上記混合周波数成分の信号を含む第1の光信号を上記第1の光伝送線路に出力する。一方、上記従基地局において、上記第1の光・電気変換手段は、上記第1の電気・光変換手段から上記第1の光伝送線路を介して伝送された第1の光信号を光・電気変換して上記混合周波数成分の信号を含む電気信号を出力した後、上記第1のろ波手段は、上記第1の光・電気変換手段から出力される電気信号のうち予め決められた第1の混合周波数成分の信号を帯域ろ波する。次いで、上記送信手段は、上記第1のろ波手段によってろ波された上記第1の混合周波数成分の信号を無線送信する。さらに、上記受信手段は、相手局において第2の情報信号で変調されて無線送信された所定の無線周波数を有する送信信号を無線受信して受信信号を出力し、一方、上記第2の信号発生手段は、所定の周波数を有する第2の局部発振信号を発生する。次いで、上記第2の電気・光変換手段は、非線形の電気・光変換特性を有し、上記受信手段から出力される受信信号と上記第2の信号発生手段によって発生された第2の局部発振信号とを、上記非線形の電気・光変換特性を用いて上記受信信号と上記第2の局部発振信号とを混合し上

記受信信号と上記第2の局部発振信号との間の少なくとも1つの混合周波数成分の信号が生じるように電気・光変換して上記混合周波数成分の信号を含む第2の光信号を上記第2の光伝送線路に出力する。さらに、上記主基地局において、上記第2の光・電気変換手段は、上記第2の電気・光変換手段から上記第2の光伝送線路を介して伝送された第2の光信号を光・電気変換して上記混合周波数成分の信号を含む電気信号を出力した後、上記第2のろ波手段は、上記第2の光・電気変換手段から出力される電気信号のうち予め決められた第2の混合周波数成分の信号を帯域ろ波する。次いで、上記復調手段は、上記第2のろ波手段によってろ波された上記第2の混合周波数成分の信号を復調して上記第2の情報信号を出力する。以上のように構成された請求項3記載の無線リンク用光伝送システムは、上記第1ないし第3の作用効果を有する。

【0018】またさらに、上記請求項4記載の無線リンク用光伝送システムは、請求項3記載の無線リンク用光伝送システムにおいて、好ましくは、上記第1と第2の光信号は波長多重されて1本の光伝送線路を介して伝送される。

【0019】上記請求項5記載の無線リンク用光伝送システムにおいては、上記主基地局において、上記変調手段は、所定の周波数を有する搬送波信号を、入力される情報信号で変調して変調信号を出力し、一方、上記信号発生手段は、所定の周波数を有する局部発振信号を発生する。次いで、上記電気・光変換手段は、非線形の電気・光変換特性を有し、上記信号発生手段によって発生された局部発振信号に応答して上記非線形の電気・光変換特性を用いて上記局部発振信号の少なくとも1つの高調波信号を発生するとともに、上記変調手段から出力される変調信号と上記発生された高調波信号とを、上記非線形の電気・光変換特性を用いて上記変調信号と上記発生された高調波信号とを混合し上記変調信号と上記発生された高調波信号との間の少なくとも1つの混合周波数成分の信号が生じるように電気・光変換して上記混合周波数成分の信号を含む光信号を上記光伝送線路に出力する。一方、上記従基地局において、上記光・電気変換手段は、上記電気・光変換手段から上記光伝送線路を介して伝送された光信号を光・電気変換して上記混合周波数成分の信号を含む電気信号を出力した後、上記ろ波手段は、上記光・電気変換手段から出力される電気信号のうち予め決められた1つの混合周波数成分の信号を帯域ろ波する。次いで、上記送信手段は、上記ろ波手段によってろ波された上記混合周波数成分の信号を無線送信する。以上のように構成された請求項5記載の無線リンク用光伝送システムは、上記第1ないし第3の作用効果を有する。

【0020】また、上記請求項6記載の無線リンク用光伝送システムにおいては、上記主基地局において、上記

変調手段は、所定の周波数を有する搬送波信号を、入力される第1の情報信号で変調して変調信号を出力し、一方、上記信号発生手段は、所定の周波数を有する局部発振信号を発生する。次いで、上記第1の電気・光変換手段は、非線形の電気・光変換特性を有し、上記信号発生手段によって発生された局部発振信号に応答して上記非線形の電気・光変換特性を用いて上記局部発振信号の少なくとも1つの高調波信号を発生するとともに、上記変調手段から出力される変調信号と上記発生された高調波信号とを、上記非線形の電気・光変換特性を用いて上記変調信号と上記発生された高調波信号とを混合し上記変調信号と上記発生された高調波信号との間の少なくとも1つの混合周波数成分の信号が生じるように電気・光変換して上記発生された高調波信号と上記混合周波数成分の信号を含む第1の光信号を上記第1の光伝送線路に出力する。一方、上記従基地局において、上記第1の光・電気変換手段は、上記第1の電気・光変換手段から上記第1の光伝送線路を介して伝送された第1の光信号を光・電気変換して上記発生された高調波信号と上記混合周波数成分の信号を含む電気信号を出力した後、上記第1のろ波手段は、上記第1の光・電気変換手段から出力される電気信号のうち予め決められた1つの混合周波数成分の信号を帯域ろ波し、また、上記第2のろ波手段は、上記第1の光・電気変換手段から出力される電気信号のうち予め決められた1つの高調波信号を帯域ろ波する。次いで、上記送信手段は、上記第1のろ波手段によってろ波された上記混合周波数成分の信号を無線送信する。さらに、上記受信手段は、相手局において第2の情報信号で変調されて無線送信された所定の無線周波数を有する送信信号を無線受信して受信信号を出力した後、上記第2の電気・光変換手段は、非線形の電気・光変換特性を有し、上記受信手段から出力される受信信号と上記第2のろ波手段によってろ波された上記高調波信号とを、上記非線形の電気・光変換特性を用いて上記受信信号と上記ろ波された高調波信号とを混合し上記受信信号と上記ろ波された高調波信号との間の少なくとも1つの混合周波数成分の信号が生じるように電気・光変換して上記混合周波数成分の信号を含む第2の光信号を上記第2の光伝送線路に出力する。さらに、上記主基地局において、上記第2の光・電気変換手段は、上記第2の電気・光変換手段から上記第2の光伝送線路を介して伝送された第2の光信号を光・電気変換して上記混合周波数成分の信号を含む電気信号を出力した後、上記第3のろ波手段は、上記第2の光・電気変換手段から出力される電気信号のうち予め決められた第2の混合周波数成分の信号を帯域ろ波する。次いで、上記復調手段は、上記第3のろ波手段によってろ波された上記第2の混合周波数成分の信号を復調して上記第2の情報信号を出力する。

【0021】以上のように構成された請求項6記載の無線リンク用光伝送システムは、上記第1ないし第3の作

用効果を有する。また、受信された無線信号の周波数変換のために、上記主基地局から伝送された光信号を光・電気変換して得られた上記高調波信号を局部発振信号として用いているので、上記従基地局において局部発振信号を発生させる発生器を設ける場合に比較して上記従基地局の構成を簡単化することができ、これによって、上記従基地局の小型化及び経済化を図ることができる。さらに、上記第1と第2の電気・光変換手段における局部発振信号として、上記主基地局で発生される局部発振信号の高調波成分を用いているので、上記従基地局と上記端末局との間の無線回線の送受信周波数の設定の自由度を従来例に比較し増大させることができる。

【0022】さらに、請求項7記載の無線リンク用光伝送システムは、請求項6記載の無線リンク用光伝送システムにおいて、好ましくは、上記第1と第2の光信号は波長多重されて1本の光伝送線路を介して伝送される。

【0023】

【実施例】以下、図面を参照して本発明に係る実施例について説明する。

【0024】<第1の実施例>図1は、本発明に係る第1の実施例である無線リンク用光伝送システムのブロック図である。

【0025】この第1の実施例の無線リンク用光伝送システムは、主基地局100と、主基地局100から所定の距離だけ離れて設けられた従基地局200と、主基地局100と従基地局200とを接続するための2本の光ファイバケーブルFC1、FC2と、従基地局200と無線回線を介して接続される移動端末局300とから構成され、搬送波信号を外部装置から入力されるベースバンド信号（以下、図面においてBB信号と略す。）でFM変調して得られるFM信号と局部発振信号とを合成した後、合成信号を非線形の電気・光変換特性を有するレーザダイオード13を用いて光変調して無線周波数に周波数変換されたFM信号（以下、無線FM信号という。）を含む第1の光信号に変換し、当該第1の光信号を光ファイバケーブルFC1を介して従基地局200に伝送するとともに、従基地局200において、第1の光信号を光・電気変換後に上記無線FM信号を帯域通過フィルタ31によって帯域ろ波し、帯域ろ波された無線FM信号を増幅した後、移動端末局300に送信することを特徴とする。

【0026】また、従基地局200において、移動端末局300から受信された無線FM信号を増幅した後、局部発振信号と合成し、当該合成信号を非線形の電気・光変換特性を有するレーザダイオード37を用いて光変調してより低い周波数に周波数変換されたFM信号（以下、低域変換FM信号という。）を含む第2の光信号に変換し、当該第2の光信号を光ファイバケーブルFC2を介して主基地局100に伝送し、主基地局100において、第2の光信号を光・電気変換した後帯域通過フィ

ルタ21によって上記低域変換FM信号を帯域ろ波し、帯域ろ波した低域変換FM信号をFM復調してベースバンド信号を出力することを特徴とする。

【0027】図1に示すように、主基地局100は、FM変調器10と、局部発振信号発生器11と、合成器12と、レーザダイオード13と、光検波器20と、帯域通過フィルタ21と、FM復調器22とを備える。一方、従基地局200は、光検波器30と、帯域通過フィルタ31と、送信電力増幅器32と、アンテナ共用器33と、送受信アンテナ40と、受信増幅器34と、合成器35と、局部発振信号発生器36と、レーザダイオード37とを備える。

【0028】主基地局100において、FM変調器10は、周波数 $f_s$ の搬送波信号を外部装置から入力されるベースバンド信号でFM変調した後、FM変調後のFM信号を合成器12に出力する。合成器12は、入力されるFM信号と、局部発振信号発生器11で発生される周波数 $f_l$  ( $f_l > f_s$ )の正弦波の局部発振信号とを合成し、当該合成信号をレーザダイオード13に出力する。レーザダイオード13は非線形の電気・光変換特性を有し、入力される合成信号を上記変換特性を用いて電気・光変換して、上記合成信号で強度変調された当該変換後の光信号を光ファイバケーブルFC1に出力し、これによって、当該光信号は、光ファイバケーブルFC1を介して従基地局200内の光検波器30に伝送される。ここで、レーザダイオード13は上述のように非線形の電気・光変換特性を有しているため、当該光信号は、搬送波周波数 $f_s$ のFM信号と、周波数 $f_l$ の局部発振信号と、周波数 $(f_l + f_s)$ のFM信号（以下、無線FM信号という。）と、周波数 $(f_l - f_s)$ のFM信号などの電気信号を含む。

【0029】従基地局200において、光検波器30は、光ファイバケーブルFC1を介して伝送されて入力された光信号を検波して光・電気変換した後、当該変換後の電気信号を、主として周波数 $(f_l + f_s)$ の無線FM信号成分のみを通過させる帯域通過フィルタ31を介して送信電力増幅器32に出力する。送信電力増幅器32は、入力された周波数 $(f_l + f_s)$ の無線FM信号を電力増幅してアンテナ共用器33を介して送受信アンテナ40に出力して、当該無線FM信号を移動端末局300の送受信アンテナ41に向けて無線送信する。

【0030】ここで、搬送波周波数 $f_s$ のFM信号は、主基地局100のレーザダイオード13において、ともに合成されて入力された周波数 $f_l$ の局部発振信号を用いてより高い周波数の無線FM信号にアップコンバージョンさせることができ、周波数変換後の無線FM信号を従基地局200の帯域通過フィルタ31によって帯域ろ波することにより、当該無線FM信号を移動端末局300への送信無線信号として用いることができる。すなわち、レーザダイオード13は、電気・光変換素子のみならず、高周波用混合器として用いる。従って、搬送波周波数 $f_s$ と局部発振信号の周波数 $f_l$ とを適当に設定することにより、上記送信無線信号となる所定の無線周波数を有する無線FM信号を容易に発生することができる。

【0031】一方、移動端末局300の送受信アンテナ41から従基地局200の送受信アンテナ40に向けて送信される周波数 $(f_l + f_s + f_d)$ の無線FM信号は送受信アンテナ40で受信された後、アンテナ共用器33及び受信増幅器34を介して合成器35に輸入される。ここで、移動端末局300から送信される無線FM信号は、周波数 $f_s$ の搬送波信号をベースバンド信号でFM変調された後、上記無線周波数 $(f_l + f_s + f_d)$ に周波数変換して得られた信号であり、周波数 $f_d$ は従基地局200と移動端末局300との無線回線における送受信周波数間隔である。合成器35は、入力された無線FM信号と、局部発振信号発生器36で発生されて入力された周波数 $(f_l + f_d)$ の局部発振信号とを合成して、当該合成信号をレーザダイオード37に出力する。レーザダイオード37は非線形の電気・光変換特性を有し、入力される合成信号を上記変換特性を用いて電気・光変換して、上記合成信号で強度変調された当該変換後の光信号を光ファイバケーブルFC2に出力し、これによって、当該光信号は、光ファイバケーブルFC2を介して主基地局100内の光検波器20に伝送される。ここで、レーザダイオード37は上述のように非線形の電気・光変換特性を有しているため、当該光信号は、周波数 $(f_l + f_s + f_d)$ の無線FM信号と、周波数 $(f_l + f_d)$ の局部発振信号と、周波数 $\{(f_l + f_s + f_d) - (f_l + f_d) = f_s\}$ のFM信号と、周波数 $\{(f_l + f_s + f_d) + (f_l + f_d) = 2f_l + f_s + 2f_d\}$ の無線FM信号などの電気信号を含む。

【0032】主基地局100において、光検波器20は、光ファイバケーブルFC2を介して伝送されて入力された光信号を検波して光・電気変換した後、当該変換後の電気信号を、主として周波数 $f_s$ のFM信号成分のみを通過させる帯域通過フィルタ21を介してFM復調器22に出力する。FM復調器22は、入力されたFM信号に対してFM復調の処理を行って、ベースバンド信号を復調し出力する。

【0033】ここで、周波数 $(f_l + f_s + f_d)$ の無線FM信号は、従基地局200のレーザダイオード37において、ともに合成されて入力された周波数 $(f_l + f_d)$ の局部発振信号を用いてより低い周波数のFM信号にダウンコンバージョンさせることができ、周波数変換後のFM信号を主基地局100の帯域通過フィルタ21によって帯域ろ波した後、FM復調することにより、ベースバンド信号を得ることができる。すなわち、レーザダイオード37は、電気・光変換素子のみならず、高

周波用混合器として用いる。

【0034】図4は、第1の実施例の主基地局100のレーザダイオード13における、入力される電気信号の電力レベルに対する出力される光信号に含まれる電気信号の電力レベルの特性例を示すグラフである。この特性の測定時の各設定値は次の通りである。

入力される搬送波信号の周波数  $f_s = 0.9 \text{ GHz}$ 、  
入力される局部発振信号の周波数  $f_l = 4 \text{ GHz}$ 、  
レーザダイオード13のバイアス電流  $I_d = 35 \text{ mA}$

【0035】図4から明らかなように、レーザダイオード13から出力される光信号に含まれ、光検波器30から出力される電気信号として、周波数変換後に、周波数  $(f_l + f_s)$  の信号と周波数  $(f_l - f_s)$  の信号が含まれることがわかる。

【0036】以上のように構成された第1の実施例の無線リンク用光伝送システムにおいては、主基地局100と従基地局200とを光ファイバケーブルFC1、FC2を用いて接続しているので、当該無線リンク系から従基地局200と移動端末局300との間で設定される無線回線への電波干渉を無くすることができる。主基地局100側で搬送周波数  $f_s$  と局部発振周波数  $f_l$  とを適当に設定することにより、従基地局200と移動端末局300との間で設定される無線回線における無線周波数を任意に設定することができるので、例えば、複数の従基地局200によってそれぞれ形成される複数のマイクロセルゾーンにおける無線周波数の設定を容易に行なうことができるという利点がある。

【0037】また、従基地局200においては、ベースバンド信号の信号処理装置を備えていないので、当該従基地局200の構成を小型化かつ経済化することができる。従って、従基地局200の所定の設置スペースで各マイクロセルゾーンにおける各無線チャンネルのための無線機を多数設置することが可能となる。

【0038】さらに、従基地局200から送信される無線FM信号の周波数の安定度は、FM変調器10内で発生される搬送波信号の周波数  $f_s$  の安定度と、局部発振信号発生器11で発生される周波数  $f_l$  の局部発振信号の安定度によって決定されるので、主基地局100におけるFM変調器10内の搬送波信号発生器の発振周波数の安定度と局部発振信号発生器11の発振周波数の安定度を高めることにより、容易に無線回線において送信信号として用いる高周波信号の周波数の安定度を高めることができる。

【0039】以上の第1の実施例において、1個の従基地局200及び1個の移動端末局300のみを示しているが、これに限らず、それぞれ複数個の従基地局200及び複数個の移動端末局300を設けてもよい。

【0040】＜第2の実施例＞図2は、本発明に係る第2の実施例である無線リンク用光伝送システムのブロッ

ク図である。

【0041】この第2の実施例の無線リンク用光伝送システムは、主基地局101と従基地局201とを備え、第1の実施例に比較し、主基地局101内のレーザダイオード13tにおいて、その非線形の電気・光変換特性を用いて、周波数  $2f_l$  の局部発振信号の第2高調波信号を発生させるとともに、当該第2高調波信号と搬送波周波数  $f_s$  のFM信号とを混合させて周波数  $(2f_l + f_s)$  の無線FM信号を発生させ、これらの電気信号を含む光信号を従基地局201に伝送し、従基地局201において、周波数  $(2f_l + f_s)$  の無線FM信号を帯域通過フィルタ38によって帯域ろ波して移動端末局300への送信無線信号として用いるとともに、上記局部発振信号の第2高調波信号を帯域通過フィルタ39によって帯域ろ波して、当該帯域ろ波した上記局部発振信号の第2高調波を、受信した無線FM信号をダウンコンバージョンするための局部発振信号として用いることを特徴としている。以下、第1の実施例との相違点について説明する。

【0042】レーザダイオード13tは非線形の電気・光変換特性を有し、搬送波周波数  $f_s$  のFM信号と周波数  $f_l$  の局部発振信号とが合成されて入力される合成信号を上記変換特性を用いて電気・光変換して、上記合成信号で強度変調された当該変換後の光信号を光ファイバケーブルFC1に出力し、これによって、当該光信号は、光ファイバケーブルFC1を介して従基地局201内の光検波器30に伝送される。ここで、レーザダイオード13tは、上記光信号に含まれる電気信号内の局部発振信号の第2高調波信号の信号レベルが概ね最大となるように、そのバイアス電圧及び入力される合成信号の信号レベルが調整される。レーザダイオード13tは上述のように非線形の電気・光変換特性を有しているもので、この状態のもとで、レーザダイオード13tから出力される光信号は、搬送波周波数  $f_s$  のFM信号と、周波数  $f_l$  の局部発振信号と、周波数  $(2f_l)$  の局部発振信号の第2高調波信号と、周波数  $(f_l + f_s)$  のFM信号と、周波数  $(f_l - f_s)$  のFM信号と、周波数  $(2f_l + f_s)$  のFM信号（以下、無線FM信号という。）と、周波数  $(2f_l - f_s)$  のFM信号などの電気信号を含む。

【0043】従基地局201において、光検波器30は、光ファイバケーブルFC1を介して伝送されて入力された光信号を検波して光・電気変換した後、当該変換後の電気信号を、主として周波数  $(2f_l + f_s)$  の無線FM信号成分のみを通過させる帯域通過フィルタ38を介して送信電力増幅器32に出力するとともに、主として周波数  $2f_l$  の局部発振信号の第2高調波信号成分のみを通過させる帯域通過フィルタ39を介して合成器35に出力する。さらに、送信電力増幅器32は、入力された周波数  $(2f_l + f_s)$  の無線FM信号を電力増

幅してアンテナ共用器33を介して送受信アンテナ40に出力して、当該無線FM信号を移動端末局300の送受信アンテナ41に向けて無線送信する。

【0044】ここで、搬送波周波数 $f_s$ のFM信号は、主基地局101のレーザダイオード13tにおいてともに合成されて入力された局部発振信号の第2高調波信号を用いてより高い周波数の無線FM信号にアップコンバージョンさせることができ、周波数変換後の無線FM信号を主基地局201の帯域通過フィルタ38によって帯域ろ波することにより、当該無線FM信号を移動端末局300への送信無線信号として用いることができる。すなわち、レーザダイオード13tは、電気・光変換素子のみならず、局部発振信号の高調波発生器と高周波用混合器として用いる。従って、搬送波周波数 $f_s$ と局部発振信号の周波数 $f_1$ とを適当に設定することにより、上記送信無線信号となる無線FM信号を容易に発生することができる。

【0045】一方、移動端末局300の送受信アンテナ41から主基地局201の送受信アンテナ40に向けて送信される周波数 $[2f_1 + f_s'; f_s' = f_s + f_d]$ （送受信周波数間隔）の無線FM信号は送受信アンテナ40で受信された後、アンテナ共用器33及び受信増幅器34を介して合成器35に入力される。ここで、移動端末局300から送信される無線FM信号は、周波数 $f_s'$ の搬送波信号をベースバンド信号でFM変調された後、上記無線周波数 $(2f_1 + f_s')$ に周波数変換して得られた信号である。合成器35は、入力された無線FM信号と、帯域通過フィルタ39から入力された周波数 $2f_1$ の局部発振信号の第2高調波信号とを合成して、当該合成信号をレーザダイオード37に出力する。さらに、レーザダイオード37は非線形の電気・光変換特性を有し、入力される合成信号を上記変換特性を用いて電気・光変換して、上記合成信号で強度変調された当該変換後の光信号を光ファイバケーブルFC2に出力し、これによって、当該光信号は、光ファイバケーブルFC2を介して主基地局101内の光検波器20に伝送される。ここで、レーザダイオード37は上述のように非線形の電気・光変換特性を有しているので、当該光信号は、周波数 $(2f_1 + f_s')$ の無線FM信号と、周波数 $2f_1$ の局部発振信号と、周波数 $\{(2f_1 + f_s') - 2f_1 = f_s'\}$ のFM信号と、周波数 $\{(2f_1 + f_s') + 2f_1 = 4f_1 + f_s'\}$ の無線FM信号などの電気信号を含む。

【0046】主基地局101において、光検波器20は、光ファイバケーブルFC2を介して伝送されて入力された光信号を検波して光・電気変換した後、当該変換後の電気信号を、主として周波数 $f_s'$ のFM信号成分のみを通過させる帯域通過フィルタ21を介してFM復調器22に出力する。FM復調器22は、入力されたFM信号に対してFM復調の処理を行って、ベースバンド

信号を復調し出力する。

【0047】ここで、周波数 $(2f_1 + f_s')$ の無線FM信号は、主基地局201のレーザダイオード37においてともに合成されて入力された周波数 $2f_1$ の局部発振信号を用いてより低い周波数のFM信号にダウンコンバージョンさせることができ、周波数変換後のFM信号を主基地局101の帯域通過フィルタ21によって帯域ろ波した後、FM復調することにより、ベースバンド信号を得ることができる。すなわち、レーザダイオード37は、電気・光変換素子のみならず、高周波用混合器として用いる。

【0048】図5は、第2の実施例の主基地局101のレーザダイオード13tにおける、入力される電気信号の電力レベルに対する出力される光信号に含まれる電気信号の電力レベルの特性例を示すグラフである。この特性の測定時の各設定値は次の通りである。

入力される搬送波信号の周波数 $f_s = 0.9\text{GHz}$ 、

入力される局部発振信号の周波数 $f_1 = 4\text{GHz}$ 、

レーザダイオード13tのバイアス電流 $I_d = 35\text{mA}$

【0049】図5から明らかなように、レーザダイオード13tから出力される光信号に含まれ、光検波器30から出力される電気信号として、周波数変換後に、周波数 $(2f_1 + f_s)$ の信号と周波数 $(2f_1 - f_s)$ の信号と周波数 $2f_1$ の信号とが含まれることがわかる。

【0050】以上のように構成された第2の実施例の無線リンク用光伝送システムは、第1の実施例と同様の効果を有するとともに、第1の実施例に比較し、主基地局201において局部発振信号発生器36を設ける必要がないので、主基地局の構成が簡単になり、その小型化及び経済化を図ることができる。

【0051】以上の第2の実施例においては、主基地局101内のレーザダイオード13tにおいて、その非線形の電気・光変換特性を用いて、周波数 $2f_1$ の局部発振信号の第2高調波信号を発生させるとともに、当該第2高調波信号と搬送波周波数 $f_s$ のFM信号とを混合させて周波数 $(2f_1 + f_s)$ の無線FM信号を発生させ、これらの電気信号を含む光信号を主基地局201に伝送し、主基地局201において、周波数 $(2f_1 + f_s)$ の無線FM信号を帯域通過フィルタ38によって帯域ろ波して移動端末局300への送信無線信号として用いるとともに、上記局部発振信号の第2高調波信号を帯域通過フィルタ39によって帯域ろ波して、当該帯域ろ波した上記局部発振信号の第2高調波を、受信した無線FM信号をダウンコンバージョンするための局部発振信号として用いる。しかしながら、本発明はこれに限らず、局部発振信号の第2高調波信号の代わりに、局部発振信号の第3、第4、第5又は第6高調波信号などの他の高調波信号を用いてもよい。

【0052】以上の第2の実施例において、1個の主基地局201及び1個の移動端末局300のみを示してい

るが、これに限らず、それぞれ複数個の従基地局201及び複数個の移動端末局300を設けてもよい。

【0053】＜第3の実施例＞図3は、本発明に係る第3の実施例である無線リンク用光伝送システムのブロック図である。

【0054】この第3の実施例の無線リンク用光伝送システムは、主基地局102と、主基地局102からそれぞれ所定の距離だけ離れて設けられた3個の従基地局200a、200b、200cと、主基地局102と各従基地局200a、200b、200cとを接続するための6本の光ファイバケーブルFC11乃至FC13、FC21乃至FC23と、従基地局200aと無線回線を介して接続される移動端末局300aと、従基地局200bと無線回線を介して接続される移動端末局300bと、従基地局200cと無線回線を介して接続される移動端末局300cとから構成される。

【0055】主基地局102において、各FM変調器10a、10b、10cと、各局部発振信号発生器11a、11b、11cと、各合成器12a、12b、12cは第1の実施例のそれらと同様に動作する。また、各レーザダイオード10a、10b、10cは、入力される合成信号にตอบสนองして第1の実施例のそれらと同様に動作して、互いに異なる第1乃至第3の波長を有する各光信号を発生し、それぞれ光合成器60に出力する。次いで、光合成器60は入力された3個の光信号を波長多重合成した後、多重合成後の多重光信号を、光合成器60の合波損失と各光ファイバケーブルFC11、FC12、FC13の損失を補償するための光増幅器61と光ファイバケーブルFC11を介して従基地局200aに設けられる光分岐回路71に伝送する。

【0056】従基地局200aにおいて、光分岐回路71は入力された多重光信号のうち第1の波長を有する光信号を選択ろ波して従基地局200aに出力するとともに、第2と第3の波長を有する各光信号を光ファイバケーブルFC12を介して従基地局200bに設けられる光分岐回路72に伝送する。

【0057】従基地局200aは、入力された光信号について第1の実施例の従基地局200と同様の処理を行なう。ここで、従基地局200aの送受信アンテナ40aと、移動端末局300aの送受信アンテナ41aとの間で第1の実施例と同様に無線回線が設定される。従基地局200aで受信された無線信号の情報を含む光信号は光合成器81に出力される。光合成器81は、後述するように従基地局200bの光合成器82から光ファイバケーブルFC22を介して伝送される光信号と従基地局200aから出力される光信号とを波長多重して合成し、合成された多重光信号を光ファイバケーブルFC21、FC22、FC23の損失を補償するための光増幅器62を介して主基地局102の光分配器

63に伝送する。

【0058】また、従基地局200bにおいて、光分岐回路72は入力された多重光信号のうち第2の波長を有する光信号を選択ろ波して従基地局200bに出力するとともに、第3の波長を有する光信号を光ファイバケーブルFC13を介して従基地局200cに伝送する。

【0059】従基地局200bは、入力された光信号について第1の実施例の従基地局200と同様の処理を行なう。ここで、従基地局200bの送受信アンテナ40bと、移動端末局300bの送受信アンテナ41bとの間で第1の実施例と同様に無線回線が設定される。従基地局200bで受信された無線信号の情報を含む光信号は光合成器82に出力される。光合成器82は、後述するように従基地局200cから光ファイバケーブルFC23を介して伝送される光信号と従基地局200bから出力される光信号とを波長多重して合成し、合成された多重光信号を光ファイバケーブルFC22を介して従基地局200aの光合成器81に伝送する。

【0060】従基地局200cは、光ファイバケーブルFC13を介して伝送された光信号について第1の実施例の従基地局200と同様の処理を行なう。ここで、従基地局200cの送受信アンテナ40cと、移動端末局300cの送受信アンテナ41cとの間で第1の実施例と同様に無線回線が設定される。従基地局200cで受信された無線信号の情報を含む光信号は光ファイバケーブルFC23を介して従基地局200bの光合成器82に伝送される。

【0061】主基地局100において、光分配器63は伝送された互いに異なる波長を有する各光信号を波長別に分配して各光検波器20a、20b、20cに出力する。ここで、従基地局200aから出力されて伝送されてきた光信号は光検波器20aに出力され、従基地局200bから出力されて伝送されてきた光信号は光検波器20bに出力され、従基地局200cから出力されて伝送されてきた光信号は光検波器20cに出力される。各光検波器20a、20b、20cと、各帯域通過フィルタ21a、21b、21cと、各FM復調器22a、22b、22cは、第1の実施例のそれらと同様に動作する。

【0062】以上のように構成された第3の実施例において、上述の損失を補償するために、光増幅器61、62を設けているので、従基地局200a、200b、200cを収容できるエリアを大幅に拡大することができる。

【0063】以上の第3の実施例において、各従基地局200a、200b、200cにおいてそれぞれ1組の送受信周波数を用いる場合は、伝送されるベースバンドFM信号は複数のベースバンド信号が時分割多重された信号であってもよい。また、各従基地局200a、200b、200cにおいてそれぞれ複数組の送受信周波数

を用いる場合は、伝送されるベースバンドFM信号は複数のベースバンド信号が周波数多重された信号であってもよい。

【0064】以上の第3の実施例において、主基地局102に第1の実施例の主基地局100を適用し、従基地局200a, 200b, 200cは、第1の実施例の従基地局200と同様の構成を有している。しかしながら、本発明はこれに限らず、主基地局102に第2の実施例の主基地局100を適用し、従基地局200a, 200b, 200cは、第2の実施例の従基地局200と同様の構成を有するように構成してもよい。

【0065】＜他の実施例＞以上の第1乃至第3の実施例において、FM変調器10, 10a, 10b, 10cを用いているが、本発明はこれに限らず、FSK変調器などの他の変調方式の変調器を用いてもよい。

【0066】以上の第1と第2の実施例において、光ファイバケーブルFC1, FC2をそれぞれ伝送する各光信号を波長多重して1本の光ファイバケーブルを用いて伝送してもよい。

【0067】

【発明の効果】以上詳述したように本発明に係る請求項1記載の無線リンク用光伝送システムによれば、主基地局と、上記主基地局から所定の距離だけ離れて設けられた従基地局と、上記主基地局と上記従基地局とを接続する光伝送線路とを備えた無線リンク用光伝送システムであって、上記主基地局は、所定の周波数を有する搬送波信号を、入力される情報信号で変調して変調信号を出力する変調手段と、所定の周波数を有する局部発振信号を発生する信号発生手段と、非線形の電気・光変換特性を有し、上記変調手段から出力される変調信号と上記信号発生手段によって発生された局部発振信号とを、上記非線形の電気・光変換特性を用いて上記変調信号と上記局部発振信号とを混合し上記変調信号と上記局部発振信号との間の少なくとも1つの混合周波数成分の信号が生じるように電気・光変換して上記混合周波数成分の信号を含む光信号を上記光伝送線路に出力する電気・光変換手段とを備え、上記従基地局は、上記電気・光変換手段から上記光伝送線路を介して伝送された光信号を光・電気変換して上記混合周波数成分の信号を含む電気信号を出力する光・電気変換手段と、上記光・電気変換手段から出力される電気信号のうち予め決められた混合周波数成分の信号を帯域ろ波するろ波手段と、上記ろ波手段によってろ波された上記予め決められた混合周波数成分の信号を無線送信する送信手段とを備える。

【0068】従って、上記主基地局と上記従基地局とを上記光伝送線路を用いて接続しているので、当該無線リンク系から上記従基地局と端末局との間で設定される無線回線への電波干渉を無くすることができる。上記主基地局側で上記情報信号の搬送周波数と上記局部発振信号の周波数とを適当に設定することにより、上記従基地局と

上記端末局との間で設定される無線回線における無線周波数を任意に設定することができるので、例えば複数の従基地局によってそれぞれ形成される複数のマイクロセルゾーンにおける無線周波数の設定を容易に行なうことができる。

【0069】また、上記従基地局においては、上記情報信号の信号処理装置を備えていないので、上記従基地局の構成を小型化かつ経済化することができ、より小さなスペースで当該従基地局を設置することができる。従って、上記従基地局の所定の設置スペースで各マイクロセルゾーンにおける各無線チャンネルのための無線機を多数設置することが可能となる。

【0070】さらに、上記従基地局から送信される送信信号の周波数の安定度は、上記電気・光変換手段に入力される変調信号の搬送波信号の周波数の安定度と、上記局部発振信号の周波数の安定度によって決定されるので、上記主基地局内の搬送波信号発生器の搬送周波数の安定度と局部発振信号発生器の発振周波数の安定度を高めることにより、容易に無線回線における送信信号の周波数の安定度を高めることができる。

【0071】また、本発明に係る請求項6記載の無線リンク用光伝送システムによれば、主基地局と、上記主基地局から所定の距離だけ離れて設けられた従基地局と、上記主基地局と上記従基地局とを接続する第1と第2の光伝送線路とを備えた無線リンク用光伝送システムであって、上記主基地局は、所定の周波数を有する搬送波信号を、入力される第1の情報信号で変調して変調信号を出力する変調手段と、所定の周波数を有する局部発振信号を発生する信号発生手段と、非線形の電気・光変換特性を有し、上記信号発生手段によって発生された局部発振信号に応答して上記非線形の電気・光変換特性を用いて上記局部発振信号の少なくとも1つの高調波信号を発生するとともに、上記変調手段から出力される変調信号と上記発生された高調波信号とを、上記非線形の電気・光変換特性を用いて上記変調信号と上記発生された高調波信号とを混合し上記変調信号と上記発生された高調波信号との間の少なくとも1つの混合周波数成分の信号が生じるように電気・光変換して上記発生された高調波信号と上記混合周波数成分の信号を含む第1の光信号を上記第1の光伝送線路に出力する第1の電気・光変換手段とを備え、上記従基地局は、上記第1の電気・光変換手段から上記第1の光伝送線路を介して伝送された第1の光信号を光・電気変換して上記発生された高調波信号と上記混合周波数成分の信号を含む電気信号を出力する第1の光・電気変換手段と、上記第1の光・電気変換手段から出力される電気信号のうち予め決められた1つの混合周波数成分の信号を帯域ろ波する第1のろ波手段と、上記第1の光・電気変換手段から出力される電気信号のうち予め決められた1つの高調波信号を帯域ろ波する第2のろ波手段と、上記第1のろ波手段によってろ波され



た上記混合周波数成分の信号を無線送信する送信手段と、相手局において第2の情報信号で変調されて無線送信された所定の無線周波数を有する送信信号を無線受信して受信信号を出力する受信手段と、非線形の電気・光変換特性を有し、上記受信手段から出力される受信信号と上記第2のろ波手段によってろ波された上記高調波信号とを、上記非線形の電気・光変換特性を用いて上記受信信号と上記ろ波された高調波信号とを混合し上記受信信号と上記ろ波された高調波信号との間の少なくとも1つの混合周波数成分の信号が生じるように電気・光変換して上記混合周波数成分の信号を含む第2の光信号を上記第2の光伝送線路に出力する第2の電気・光変換手段とを備え、上記主基地局はさらに、上記第2の電気・光変換手段から上記第2の光伝送線路を介して伝送された第2の光信号を光・電気変換して上記混合周波数成分の信号を含む電気信号を出力する第2の光・電気変換手段と、上記第2の光・電気変換手段から出力される電気信号のうち予め決められた第2の混合周波数成分の信号を帯域ろ波する第3のろ波手段と、上記第3のろ波手段によってろ波された上記第2の混合周波数成分の信号を復調して上記第2の情報信号を出力する復調手段とを備える。

【0072】従って、当該請求項6記載の無線リンク用光伝送システムは、上述の効果を有する。また、受信された無線信号の周波数変換のために、上記主基地局から伝送された光信号を光・電気変換して得られた上記高調波信号を局部発振信号として用いているので、上記従基地局において局部発振信号を発生させる発生器を設ける場合に比較して上記従基地局の構成を簡単化することができ、これによって、上記従基地局の小型化及び経済化を図ることができる。さらに、上記第1と第2の電気・光変換手段における局部発振信号として、上記主基地局で発生される局部発振信号の高調波成分を用いているの\*

\*で、上記従基地局と上記端末局との間の無線回線の送受信周波数の設定の自由度を従来例に比較し増大させることができる。

#### 【図面の簡単な説明】

【図1】 本発明に係る第1の実施例である無線リンク用光伝送システムのブロック図である。

【図2】 本発明に係る第2の実施例である無線リンク用光伝送システムのブロック図である。

【図3】 本発明に係る第3の実施例である無線リンク用光伝送システムのブロック図である。

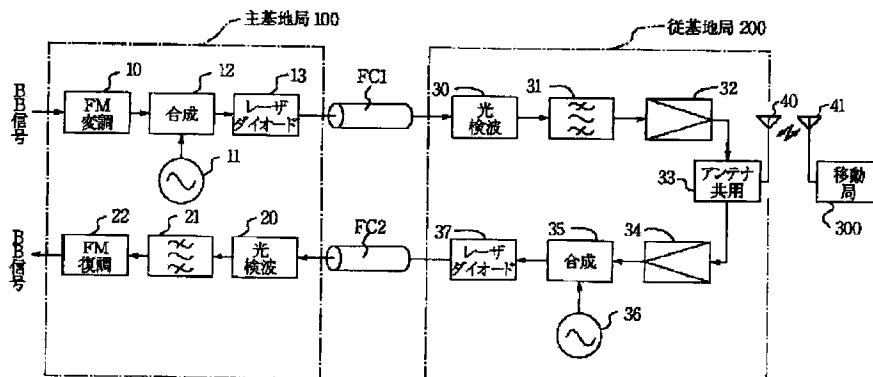
【図4】 第1の実施例における主基地局のレーザダイオードにおける、入力される電気信号の電力レベルに対する出力される光信号に含まれる電気信号の電力レベルの特性例を示すグラフである。

【図5】 第2の実施例における主基地局のレーザダイオードにおける、入力される電気信号の電力レベルに対する出力される光信号に含まれる電気信号の電力レベルの特性例を示すグラフである。

#### 【符号の説明】

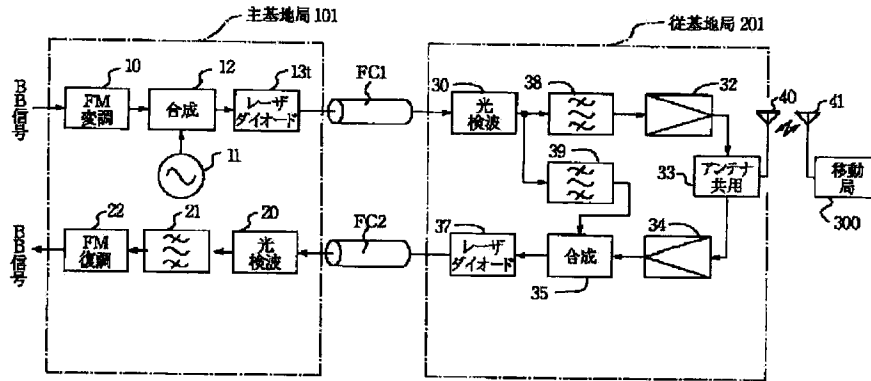
- 10…FM変調器、
- 11、36…局部発振信号発生器、
- 12、35…合成器、
- 13、13t、37…レーザダイオード、
- 20、30…光検波器、
- 22…FM復調器、
- 21、31、38、39…帯域通過フィルタ、
- 32…送信電力増幅器、
- 34…受信増幅器、
- 40、41…送受信アンテナ、
- 100、101…主基地局、
- 200、201…従基地局、
- 300…移動端末局、
- FC1、FC2…光ファイバケーブル。

【図1】

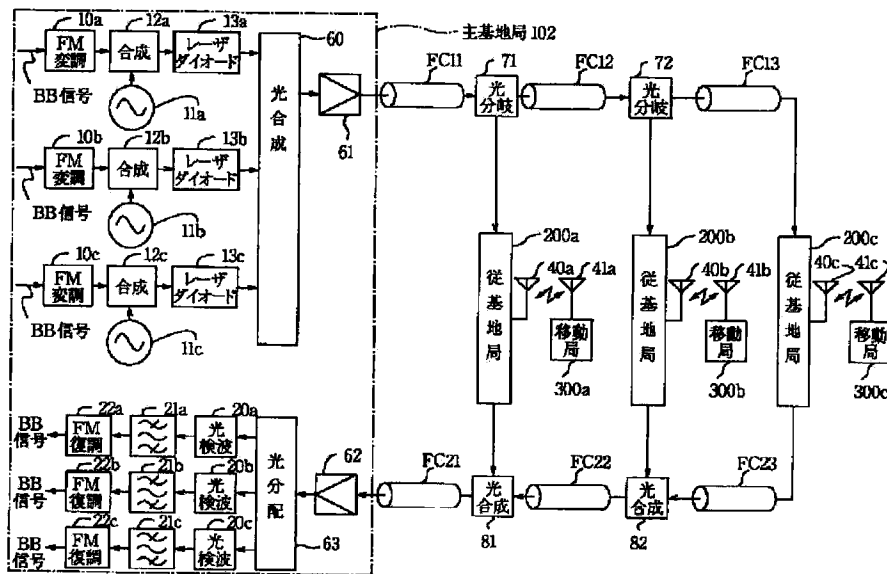




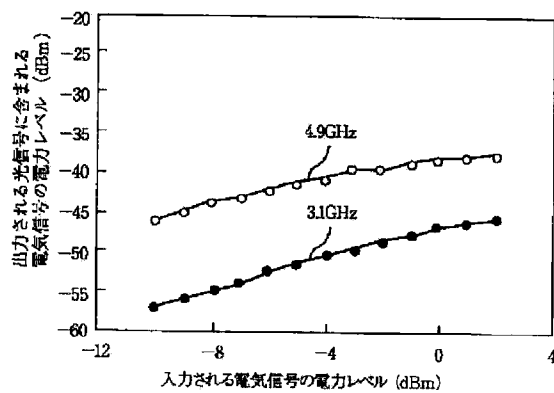
【図2】



【図3】



【図4】



【図5】

